MELBA'S Plant Lessons

FANNIE M. OLIVER

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A Nature Reader for Children
of the
Third *and* Fourth Grade

By
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PREFACE

To Mothers and Teachers:

This volume is intended for a supplementary reader and to be used in connection with specimens as far as possible.

A writer on Art, in speaking of originality, said that "It consists in the power of combining and transfusing, digesting and assimilating the material that comes into our possession from any source whatever."

Such is the only originality claimed in this volume. To the boys and girls is this book inscribed, hoping the information may aweken a real desire for a thorough knowledge of plant life, and may it be as interesting to those who read and study it, as its preparation has been to your friend

THE AUTHOR.

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INTRODUCTION.

Little Melba Andrews was born in the early part of the year 1870, in the western part of New York State, but went with her parents, when a baby, to live on a large ranch, far to the southwest, many miles from any town or settlement. Melba grew as the years passed, and soon became a big girl. You will no doubt think she must have been very lonely, when you learn that she had no brothers or sisters, and that there were no other children near to play with her. But Melba had a beautiful home. It was surrounded with so many interesting and wonderful things, and she was early taught to notice and enjoy them, and therefore had no time to think of her loneliness. But when she reached school age, the monotony of her life was broken, because her parents had a school room erected and beautifully furnished with modern equipment, and secured the services of an excellent governess for her.

Melba enjoyed the change, and Miss Williams, her teacher, enjoyed being with her. Melba was bright and learned fast, and before she was ten years old, had developed into quite an intelligent little scholar.

Besides the information obtained from her books, Melba learned many things from her surroundings. The ranch was a great school; her home was an ideal one; the house was large and commodious. Rare plants filled the large verandas and the spacious lawn that surrounded the handsome mansion, was dotted with many beautiful flowering shrubs.

Many varieties of wild birds nested in the forest trees that still grew on the lawn. Altogether it formed a pleasing picture, and Melba never tired of it.

Mr. Andrews conducted his ranch on a very extensive scale. He raised live-stock, poultry, fruits and vegetables for marketing, and from a very little girl, Melba had accompanied her papa on his inspecting tours of the farm. On her trips with him, she had seen many things that interested her and aroused her curiosity. Her papa did not have time to answer the questions she wanted to ask concerning many of the things she saw, but now that she had a teacher, whose delight it was to instruct her, she would wait until she returned to ask her. Miss Williams was interested and endeavored to give her just the information she needed on the subjects that came up.

Melba was very much interested in vegetable life and things of nature generally. The extensive sloping meadows, the large

streams and the little river-lets; the many wild flowers that grew along the road-side and in the meadows; the wild birds, butterflies and other insects not only attracted but interested her greatly.

She enjoyed the life and activity of the growing and ripening season, but the fading of autumn somehow did not impress her. One day late in the fall her teacher noticed that she was not preparing to go with her papa as usual, and asked her why. "I don't care to go now, Miss Williams; there is nothing to see. Everything is dead and dried up."

"Yes, they do look dead, dear," said her teacher, "but they are only asleep. It is nature's night time, and the mother has put all her plant children to bed."

"What mother, Miss Williams?"

"Mother Nature, Melba. She has also sent the insects to their winter homes, and the birds that sang so sweetly all spring, summer and early fall, to a faraway country where it is warm. Just as we put off our clothes when we have finished our day's work and go to sleep, so the trees and plants have finished their's for this season and are simply resting until the time comes for them to begin their work again. You watch and you will see when spring comes, all the trees and plants that now appear dead, will awake and life will return."

"That seems so very strange. I cannot see how it can be true."

"Yes, but it is true, and all you have to do is to wait and see."

The dreary winter days finally passed, and spring made its appearance.

"Well, spring is here at last, Melba," said her teacher, as she tore from the calendar the February leaf and exposed the days and dates of the new month that had just arrived. "March, the first spring month, is here."

"I am glad, I am very glad spring has come. Why do they call the season that follows winter spring?"

"Because it is the season in which all nature awakes from the resting period, as I told you, and spring, into life and activity. Now, Melba, I want you to give attention and observe closely the changes that occur in the vegetation and animal life that surrounds you."

Melba did as her teacher told her and many times she said, I am looking but I see no change in any way. But at last she saw the snow melt from the hill-sides and the ice-bound streams liberated. She noted the meadows, that for many weeks had been brown and dry, taking on a covering of green; the change in forest and field, and the growth and development of bud, stem, leaf, blossom and fruit on trees and

plants, that a while before seemed lifeless, told a wonderful story to Melba.

After the days grew sunny, Melba began her visits to the farm when it was convenient for her to go. She now enjoyed them in a different way to what she did at first. She made many trips during the planting time, and saw and heard many things she did not understand and would have to ask her teacher on her return home.

One day, after her visit with her papa to the garden, she said to her teacher: "I heard papa tell the foreman today, to see that the related vegetables were not planted too near each other. What did he mean?"

"He meant just what he said, Melba. When vegetables that belong to the same family group, grow too near each other, they mix in a way that spoils them, and your papa wants the purest vegetables that can be produced."

"Will you please name some of the related plants?"

"Yes; the horse radish, the turnip, the cabbage, the radish and mustard plants, are related. They have the same nature and belong to the same plant family."

"Why, do plants have families?"

"Yes, dear. Every plant, however large or small, is a member of some family, and has a distinct family name."

"I don't see how one would know them

apart, there are so many different kinds of plants."

"That is true, dear, but those who make plant life a study, find there are certain likenesses in character, by which they can classify them and tell to what family they belong."

"How very much I would like to know our plants, by their family names."

"Well, perhaps you will, when you get to be an older girl, and have more time to get acquainted with them."

"I think plants are hard to understand anyway, Miss Williams. I can't see how they grow. A few weeks ago, papa and I saw the men planting beans, and that ground is green with little plants now. I cannot see how such a plant can grow from a bean."

"Well Melba, it is easy enough when you understand it."

"I would like very much to understand it."

Miss Williams was puzzled and wondered how she might be able to answer Melba's question in a way that she would understand. After much thought on the subject, she decided the best way to answer the question would be to plant some beans, and let Melba watch them grow.

THE BEAN.

One day not long after the last conversation, Melba found a dish on her desk, containing several beans. "What must I do with these beans?"

"Examine them closely, dear, then cover them with water and set the dish aside."

"Why they are only beans, there is nothing to see."

"Well, put the water on them, and set them aside as I told you."

Melba did as her teacher told her, and proceeded to her studies. The next day when the study hour came, the teacher told Melba to bring the dish with the beans with her.

"Let us examine these beans again," said the teacher. Melba took one of them and seemed surprised to see it so changed. "What difference do you see in the bean since you put it in the water?"

"It has become very much larger."

"Take this pin and remove the skin. What happened to the bean when you took the skin off?"

"It separated in two parts."

"Then what do you think the skin is for?"

"I should think to hold the parts of the bean together."

"Yes, and to protect them," said Miss Williams. "You see, Melba, the bean is made of two thick leaves. They are the seed leaves. But they have a special name that you must remember. They are the Cotyledons. Hereafter when we speak of seedleaves we shall call them by their name. Look on the inside of the Cotyledons, and you will see a little plant. Can you see it?"

"Why, yes, I can. How do you suppose it got there? Did it grew there as the bean grew?"

"Yes, it did, and that is what I want you to know. A little plant grows in every bean. The bean is the sleeping place, or cradle for the baby bean plant. It sleeps in there as did the trees and flowers you saw during the winter. But when spring comes, and the bean is put in the ground, the soil warmed by the sun, and moistened by the rain, wakes up the baby plant, and it creeps out, a tiny little plant as you saw in in the field. And with proper care and attention it will grow to a big plant and bear beans. Now Melba, set the dish away, and tomorrow we will find out something more about the bean."

When Melba went for a drive that afternoon, the things she saw had a double interest for her. She remembered the beau-

tiful lesson she had learned, and could hardly wait for the time when she was to continue the lesson.

When the study hour came again, Melba was told to bring her dish with the beans again. The teacher said to her, "Take a bean and show me the Cotyledons, Melba. Take this microscope and find the little plant. Do you see it?"

"Yes, I do."

"Well, the little plant has a name also. It is the embryo or the being from which the big plant grows. Look at the embryo closely, and you will see at one end of it a bud. Do you see it? That is the bud from which the leaf grows, and is called the plumule. Look at the other end of the embryo. What do you see?"

"A little stem."

"Yes, and from that little stemlet the root forms. It is called the radicle. Now, Melba, your questions concerning the bean have been answered. You have learned that the bean is simply the cradle in which a baby bean plant sleeps until under the proper conditions it begins to grow and leaves its resting place. Take the bean now, dear, and show me the cotyledons or seed leaves, the embryo, the plumule and the radicle.

"Now, Melba, you have learned that the little plant is a real living thing, and for

that reason when it begins to grow it must have food to live on, just as other living things must have. Mother Nature has provided for that, and has so formed the mama plant, that as she bears the bean she also stores up enough food in the cotyledons for the baby plant to subsist on, until it is able to work for itself."

Melba was interested in the lesson and wanted to continue the talk.

"What shall I do with these other beans?" she asked.

"We are going to plant them," said the teacher. They went together to the garden, and prepared the soil. They made some little hills a few spaces apart and planted the beans. "We must not cover them too deeply, dear," said the teacher. "Pour the water that is in the dish on the hills."

Melba did as she was told, and left the beans to grow. When the school hour was over, Melba went for her usual recreation, but her mind was on her nature lesson. She thought continually of what she had heard, and wondered how the beans were getting along in the dark, damp earth and how the air and sunshine could reach through to wake up the sleeping baby plants, when their cradle is buried so deep in the soil.

A few days after the last lesson, the teacher told Melba to take up one of the beans and bring it to the class-room. Melba

hardly recognized the bean as the one she had planted. She was surprised to find a little rootlet almost an inch long growing from one end of the cotyledons. "Look, Miss Williams, how this little plant is coming out."

"Yes, dear, the bean has been working very hard."

A few days later the second bean was taken up. It had two little leaves, and a root about two inches long. "Just look how this little plant has been growing!"

"Yes, you see one end has been growing down into the dark earth to make roots, while the other was stretching up to find the warm air and sunshine."

The third plant was left to grow. Melba took great delight in watching and tending it. She noticed all the changes that took place. It grew to be a very large bean plant. In due time the buds began to appear and finally it was covered with little white blossoms. They soon withered and dropped off, and tiny green pods appeared in their places. Melba reported to her teacher that the plant is full of little bean pods. They grew larger and larger, until Melba said one day, "I can almost get beans enough for dinner off my plant." But her teacher told her not to pull them, but to watch, and notice what other change will take place in the plant.

A few weeks passed before Melba spoke

of her plant again and when she did, she told her teacher: "The plant is dead, now, Miss Williams."

"Well, pull it up and bring it to class with you."

Melba did so. As she laid the plant with its dry pods on the desk, several of them burst open and a number of the beans fell out.

"We seem to be right where we started," said the teacher.

"Yes, but these are new beans," said Melba, "and we only planted one bean for this plant, and here we have many."

"So we have. Now, Melba, if we should plant these beans they will bring new plants."

"Where did this plant come from?"

"It came from the bean we planted. Where are our bean plants for next year, Melba?"

"They are in these beans."

"How must we obtain them?"

"We must plant the beans and let them grow and bear them."

'What part of the bean will grow into a plant?"

"No part. The plant is already formed in the bean and will come out of it, when we plant it."

"Do you understand now, Melba, how the men planted beans and obtained plants."

"Yes, Miss Williams. Do all seeds hold a baby plant?"

"Certainly they do. What did we call the baby plant in the bean?"

"We called it the embryo."

"Yes, and any seed that has no embryo will not produce a plant. What did these pods do?"

"They held the seed."

"Then we can say they are the seed-holders."

"When we eat string beans we are eating the seed-holders?"

"Yes, and we can also call that part of the plant, the fruit. The fruit holds the seed. What did these pods grow from?"

"They grew from the blossom."

"Now, Melba, let's have the process. First the bud, then the blossom from which comes the fruit, and then the seed, that holds the future, or new plant."

"I see, Miss Williams."

"Now, Melba, these take no part in nourishing the plant. Their work is to give or reproduce new plants, and are therefore called the organs of reproduction."

"Miss Williams, why did this plant dry up and die so soon? Why didn't it remain green like other plants in the garden?"

"It had finished its work, Melba, and the sap ceased to flow in the veins of its stems. The sap, you know, is that watery substance

that you find in all plants when you break or cut them. You have noticed it, haven't you?"

"Why, yes, I have."

"When the plant has finished the work Mother Nature has given it to do, the sap stops and the plant drys up."

Melba sat holding the withered plant for some time.

"What did the plant do when it first came out of the seed-cradle, Melba?'

"It grew until it became a grown plant."

"What parts of the plant were mostly concerned in its growth?"

"I think the roots were."

"Yes, the roots, stems and leaves. They were the most concerned, because they came first. They are called the organs of vegetation. It is true in all plants. The root descends into the ground, and sends its branches in all directions through the soil, for the purpose of finding food for the plant. The stem is the ascending portion. It bears the leaves and flowers. The leaves breathe for the plant and digest the food taken by the roots. Now can you name the organs of vegetation, Melba? Yes, they are the roots, stems and leaves. The lesson is over now, dear, and you may go. Take the plant with you."

What must I do with it, Miss Williams?"

"Anything you choose. You are through with it."

"I wish I could keep it for I have really enjoyed having it so much, I hate to part with it."

"Why not draw the picture of it then, Melba? You can keep it."

"So I will," said Melba.

"If you do, make your picture tell the whole story. Begin with the bean and draw it as you saw it, in the different stages of growth. Then write a story about it, and bring both to class wih you, when you have finished them."

A few weeks passed, then Miss Williams said:

"Melba, it is nature study today, so you may bring your picture and story of the bean plant." She examined the work closely and was much surprised at the exactness of the drawings, and the many facts of the lesson brought out in the story.

"This is good, Melba. I see you remember well. We will have some lessons like this some time."

"Yes, Miss Williams, you said you would tell me something about the plant families, and I think this is a good time to begin."

"Yes, Melba, I did say some time we would take the plant families, but I had not thought of doing it at this time. There are a great many things that you must know

about plants, Melba, before you will be able to take them by families."

"Oh, please tell me what they are, I must know."

"Well, Melba, you must know how plants grow; what kind of food they take; why roots, stems and buds differ; why leaves are not arranged on stems alike; you will have to see the difference between leaves, flowers and fruit, taking under consideration their many shapes, colors and kinds. What growth is, and how it is carried on; why plants grow; how trees increase in height; how a stem grows from a bud, in the embryo to a tall vine, and how a tiny plant in the seed can develop into a large one; why some stems have branches and some have not; what action in plant life is, and how it is carried on; what gives color and form to leaves, buds and flowers. You will also have to learn about the kinds of roots, stems, leaves, buds, flowers, fruit and seeds before you are ready to study the plants by families."

Melba looked at her teacher and left the class room in silence.

THE TALK ON GROWTH.

Section A.

When the hour for the plant lesson came again Miss Williams said to Melba: "We shall take up our work on plant-life now, Melba, and try to answer those questions we had the other day.

"Our first talk will be on growth: Growth is the increase of a living thing in size and substance. It is the building up of the plant out of vegetable matter. Vegetable matter is made of mineral matter, and mineral matter is drawn from the earth and air."

"Where is the vegetable matter made, Miss Williams?"

"It is made in the leaves of the plant. Plants are fixed to the earth, as you know, and therefore have not the power of locomotion but nevertheless, they work very hard. They are continually in action and that action is called vegetating. Vegetating consists of two things—assimilation and growth. In assimilation, the plant is changing mineral matter; that is air, water and a little earth into vegetable matter. In growth this vegetable matter is made

into all manner of beautiful forms and colors.. This, Melba, is the great work of the plants all over the world, and it is their peculiar work. Only plants have the power of changing air, water and earth into vegetable matter. To grow into a plant the embryo in a seed must be fed with this vegetable matter, or with something out of which vegetable matter can be made.

"When a plant has sent down roots in the soil and spread out some leaves in the dirt, it is then able to change mineral matter into vegetable matter, and so to live and grow independently. But at the beginning, before its organs are developed and established in their proper places, the forming plant must be supplied by ready-made vegetable matter furnished by the Mother Plant.

"The young plant has all the organs at first that it will have except those that belong to the blossoms. It has only to grow and make more of what it already has; more stems, more leaves and roots to draw more nourishment from the soil. As fast as the plant makes new vegetable material, it uses it to increase its size and strength. It adds to its roots below and its stems above. It unfolds a new leaf, or a pair of leaves on every joint. Each joint of stem soon gets its full length and its leaf or pair of leaves their full size. Then instead of continuing their growth, these parts set to

work to prepare nourishment for the growth of the young parts that are forming above them. In this way, Melba, piece by piece, the stem is carried up higher and higher, and its leaves increased in number.

This closes the talk now, dear. The next time we shall talk about the growth or development of stems, branches, leaves and buds, which will include their formation and arrangement. You must go now, Melba, your papa is calling you. He is in the buggy waiting for you."

Melba was glad to go with her papa this time. . As she looked at the growing vegetables and other plants, they appeared so different to her to what they did before, she had learned so much about them. She thought, dear plants. I am so glad to know that you are real living things with work to do, and that you are so industrious and never leave any of your work undone. I am glad that you have a mother and are members of a family, that you have a name, some cousins and a home. Some day I shall know you better and then I will call you by your name.

BUDS AND BRANCHING.

"We shall have a talk on stems today, Melba. There are two kinds of stems; those with branches and those without. The stems that have no branches are called simple stems. There are many plants, and some trees that have simple stems, but usually when stems grow they form branches.

"Branches are also formed by roots. There is no particular arrangement about the branches that spring from roots, because they send them off from any part of the main root. But the branches of stems that spring from particular places are arranged on a regular plan. They arise from the axil of the leaf and no where else."

"What is the axil of the leaf, Miss Williams?"

"It is the space just above where the leaf is attached to the stem or tree. As branches come only from the axil of the leaves, and since the leaves have a perfectly regular and uniform arrangement in each plant, you see, Melba, that the places where the branches come were fixed for them by

the position of the leaves and they must follow their arrangement. Therefore the branch is not an independent, but an irregular growth.

"Branches first appear in the form of buds. Buds are therefore undeveloped branches, leaves or flowers, Melba, and if they were so arranged that you could look into the buds, you could see which they contain before they open. The plumule or first shoot of the embryo is a bud. That bud makes the main stem, and its growth week after week, or year after year, carries on the stem. It is always on the end of the stem, and is therefore called the terminal bud.

"The buds that form the branches appear on the sides of the stem. Since they are situated in the axils of the leaves, they are called axillary buds. These buds grow into branches just as the first or terminal bud grows to make the main stem. The arrangement of the branches, therefore, follow that of the axillary buds, and the arrangement of the buds follow the arrangement of the leaves.

"Leaves come on the stem in two ways. They are either alternate or opposite. They are alternate when they follow each other, there being only one to each joint of stem, as they grow on this morning glory vine. Look at it, Melba. The arrangement is also seen in this spray from the linden tree. I

grew this vine and put this twig in water that the leaves would develop so you could see the alternate arrangement.

"Leaves are opposite when there are two leaves on each joint of stem, as in these sprays from the horse-chestnut, lilac and maple. One leaf in each case is always on the opposite side of the stem, from its fellow. In the axil of almost every leaf a bud is formed.

"Look at this spray from the linden tree again. The buds are axillary and alternate like the leaves. It also has a terminal bud. This twig of the maple has its axillary buds opposite, and a terminal bud also. Next spring these alternate buds will grow into alternate branches and these opposite buds into opposite branches. These branches in their turn form buds in the axils of their leaves that grow into branches and so on year after year. You thus see, Melba, while the buds and branches vary in their arrangement on the stem, there is a perfect regularity in their placing thereon.

Each variety is arranged its way and is unchangeable. You can best learn that it is an established fact by examining the buds themselves."

"When is the best time for the examination, Miss Williams?"

"In the winter time, dear, when the twigs are bare. You can also tell where the

leaves of last year were, by noticing the leaf scar, for each fallen leaf has left a mark where the branches will appear, for their buds are also conspicuous.

"I have some twigs here for you to look at. This one is from the horse-chestnut. These are the leaf-scars that we were talking about. Can you tell me the arrangement of the buds "

"Yes, they are opposite."

"That is right. What will you call the large end bud?"

"It is the terminal bud."

"Certainly it is. I see you do remember. Here is a twig from the hickory tree. What can you say about the arrangement of its buds?'"

"They are alternate and are placed just above the scars."

"Is there anything else noticeable about it?"

"Yes; it also has a large terminal bud."

"Well, we will stop now, dear. Our next talk will be on buds. The subject is so closely connected with the subject of branching, that we decided to take the two together, and so our next talk will simply be a continuation of the one we had today. Meanwhile, Melba, as you pass around among the trees and plants, give attention to the arrangement of leaves and buds upon the stems of the plants you, see, and it will help you to classify them.

THE TALK ON BUDS.

"We will begin our talk on buds today, Melba. The bud forms a very important part of plant life. All buds are formed toward the close of the growing season, or in the fall, and must stand the cold weather. They are therefore protected from the frost by a covering.

"Let's notice some of their coverings. These are the buds of the horse-chestnut and balm of Gilead; they are covered with a sticky substance. Buds take their name from their covering. These with no protecting scales are called naked buds, and these that have a protection formed of altered leaves or bases of leaves are called scally buds. Look at these buds; they are from the willow and poplar trees. You see they are as if varnished. These are from the surmac and these from the hickory. They have a woolly covering. The apple, hazel and lilac have a scally one.

"Thus you see, Melba, the Mama plant knows just what to do for her babies. Mother Nature tells them when the long busy work day that began with the spring time is over, to put all the baby branches,

leaves and flowers that are to come forth the next spring in their tiny cradles, covered well with soft woolly blankets, where they are to sleep through the long winter days. But when spring comes, and they feel the warm sunshine, they will push aside their warm blankets and come out."

"I think this is a most beautiful lesson, Miss Williams. I really love to hear about the Mama plant and how she obeys Mother Nature."

"I am so glad you do enjoy the lesson, Melba.

"There is also a regular order in which the leaves are wrapped in the leaf-bud, Melba, and we must talk a little about that, before we leave the bud subject. They are, of course, arranged differently in different plants. The most common arrangement is called the inflexed. It is found in the bud of the tulip-tree. The leaf is folded in the bud, from apex to base. In the flower-de-luce, the leaf is rolled from apex to base. That is called the cincinate arrangement. In the bud of the plum-tree, the leaf is rolled spirally, so that one edge is in the center of the coil. That is called the convolute arrangement. The leaf in the bud of the apple-tree has both edges rolled inward toward the mid-rib. That is called the involute arrangement. In the willow we have the edges rolled outward toward the mid-

rib. That is called the revolute arrangement. In the bud of the peach tree is found the conduplicate arrangement. In that the leaf is folded along the mid-rib so that the two halves are brought together. The plicate arrangement has the leaf in the bud, folded several times lengthwise like a fan. We find it in the bud of the birch-tree. The obvolute has both edges of the blade folded together, the opposite ones half inclosing each other. It is found in the dogwood tree. Now later, Melba, you will understand this talk better, when you shall have had the parts of the leaf. But it was better to take it, while we were on leaf and bud arrangement. The lesson is over, and you are excused."

"What shall we have next, Miss Williams."

"We are going to take the kinds of buds."

TALK ON THE KINDS OF BUDS.

"We are to talk today, Melba, on the kinds of buds. There are three kinds: leaf buds, flower buds and mixed buds. Leaf buds contain only leaves, and flower buds contain only flowers, while mixed buds contain both leaves and flowers.

"Look at these buds, Melba; they are from the horse-chestnut and hickory. They are very strong. Buds like these have an indefinite annual growth. They generally contain already formed leaves and the joints of stems they are to produce. They usually make their whole growth in length in a few weeks and sometimes in a few days. Then they form and ripen their buds for the next year.

"Indefinite annual growth is also well marked in such trees or shrubs as the honey, locust, surmac and the steril shoots of the rose, blackberry and raspberry. Such shoots are apt to grow all summer, or until they are stopped by the frost of autumn. Therefore they form and ripen no terminal bud that must be protected by scales. In such cases, the upper axillary bunds are produced so late in the fall they have no time to

mature, nor has their wood time to solidify and ripen. Such stems usually die from the top in the winter, or if they do not, their buds are small and feeble. In such cases the growth of the succeeding year takes place mainly from the lower axillary buds."

"Does that have any effect on the appearance of the plant?"

"Why yes, dear, wherever axillary buds take the lead, there is no single mainstem in a direct bud, continued year after year, but the trunk is soon lost in the branches. Trees so formed commonly have rounded or spreading tops. The common American elm, is a good illustration. The first time we are out among the trees, I will call your attention to the tree."

"I wish you would, for I would like to know, for it will help me remember the lesson I had on that form of growth."

"Yes, it will help you remember. In the firs and spruces we have specimens of growth, where the main stem is carried on in a direct line throughout the whole growth of the tree, by the development year after year of a terminal bud.

"Now, Melba, this finishes the talk on the subject of growth. The only way you can be profited by these talks, will be to observe the trees and plants as you go out in forest, field and meadow.

"Our next talk will be on the duration of plants. You may go now,"

Melba ran out on the lawn. The grass, trees and flowers seemed to look different to her, and as she turned about and looked at them she said: "Oh! you pretty things! What a wonderful mother you have, and you are her good children, too, for you do just the thing she has given you to do."

THE TALK ON THE DURATION OF PLANTS.

"The length of time, Melba, that plants endure, varies greatly. Some live only a few weeks, or months, and others last many years. The most familiar division of plants, according to their duration are herbs, shrubs and trees. Herbs are plants of soft texture. They have little or no wood in their stems, and when the season of their growth is over they die. Shrubs are plants with woody stems that endure and grow year after year. They do not reach any great height, but remain low and bushy. Trees are woody plants that arise by a trunk or main stem to a greater height than shrubs.

"Herbs are divided according to their duration, into annuals, biennials and perennials. Annuals grow from the seed; they blossom and die all in the same season. They come from the seed in the spring and die in the autumn, as the flowers that adorn the walks and other common plants seen about the roadsides, in the field and meadows. Plants of this kind, Melba, have roots of long, slender threads or fibers. It is the fibers that mainly absorb moisture from the soil, and the more numerous they

are, the more strength the plant has. As fast as nourishment is received, it is expended in making new stems and leaves, and finally in preparing flowers, fruit and seed. Annual plants continue to bear flowers in great numbers until they exhaust themselves and die."

"Why, Miss Williams, that is the way the bean plant did. And since then I have noticed other plants do the same way."

"Well, I am glad you have noticed them. They do not die until after they have ripened their seeds from which the new plants are to come the following spring, remember.

"Biennial plants differ greatly in duration from annual plants. They do not blossom at all the first season, but live through the winter, blossom the second year, ripen their seed and die. The beet, carrot, parsnip, cabbage and turnip are biennial plants. They have fleshy roots and are mostly made of leaves and roots. They work very hard. The food taken in by the leaves and roots is changed into vegetable matter by the leaves, and is carried down into the root and is there stored for the next year's use. So you see, the root of the biennial plant becomes large and heavy, being a storehouse of nourishing matter that is very useful.

"Perennials are plants that live year after

year. Trees, shrubs and some herbs are perennial plants. Only a portion of the herb survives through the winter."

"Miss Williams, please name some herb that does not die with the summer."

"The peony, the dahlia and the sweet potato are herbs whose roots survive during the winter season. They contain the buds from which the next year's plant will grow. During the growing season there is a great quantity of nourishing matter stored up in the wood, bark, shoots, trunk and roots of shrubs and trees."

"What becomes of that nourishment?"

"It is that on which the buds of the next spring feed, and it enables them to develop. It clothes the naked branches with leaves and blossoms.

"It is wonderful how Mother Nature provides for her children. The grass that seems to spring up spontaneously after a spring shower and a few sunny days, was all prepared before hand. The leaves that were made the summer before and tucked away in winter buds, unfold much faster because of the nourishment that was prepared by the Mama plant, and laid away till needed. The many flowers that bedeck the plants in summer, do so without toil of their own, because the root and leaves of the Mama plant before them gathered the material from the earth and air and made it into

vegetable matter, and stored it away underground where the buds were put to slumber in bulb, root and seed.

"Well, Melba, we have finished our talk on the duration of plants, and our nature lessons hereafter will be on the parts of the plant."

"What part will we take first, Miss Williams?"

"We will take the root. You may go now, Melba, and I will let you know when I am ready for another nature talk."

ROOTS.

"We are ready to begin our talk on roots today, Melba. The root, if you remember, is one of the organs of vegetation. Roots are produced by stems. It is usually supposed that stems spring from roots, but they do not. The first root of a plant, you have learned, is a downward growth from the root end of the stem of the embryo. If it grows on it makes a main, or tap root, as it is called. Here is a specimen of the tap root; this is the oak-seedling. Many plants that have this kind of root, keep it throughout their whole life, and send off only small side branches, as are seen in the carrot, radish and turnip."

"What difference is there between stems and roots, Miss Williams?"

"Stems, Melba, are the ascending axis of a plant, while roots are the descending ones. Stems are built up by a succession of leaf bearing growths. These growths are strongly marked in the stems of reeds and corn stalks, but are not so much so in other herbs. We speak of these places of growth as joints, but that does not convey the real meaning, as it may mean either the

portion between successive leaves, or where they are attached. For precision, therefore, the place where the leaf or leaves are borne is called the node, and the naked interval betwen the two nodes is called the internodes. Stems grow by successive developments of internodes, one after another, each bearing a leaf at its summit or node. So you can see, Melba, it is essential for a stem to bear leaves. Roots do not bear leaves. They have no nodes nor internodes. They grow on continually from the lower end. They commonly bunch freely, but not from any definite order. Although roots do not give rise to stems, there are some exceptional cases of which we must speak. Since stems produce adventitious buds, roots may also produce them."

"What are adventitious buds, Miss Williams?"

"They are buds that come by accident, or they just happen to come. The roots of the sweet potato among the herbs, and the Osage orange among the trees, produce adventitious buds that develop into leafy shoots. Those plants are propagated by root cuttings. Most growths of subterranean origin, that pass for roots, are not roots, but forms of stems. In the common potato, for an example, the root, as you have learned, serves the double purpose of fixing the plant to the soil, and absorbing

the food and nourishment necessary for its growth. Now, Melba, we will stop for today, and at our next talk we will confine it mostly to roots."

CONTINUATION OF TALK ON ROOTS.

"We are to continue our talk on roots today, Melba."

"I am so glad, Miss Williams, for since they are the part of the plant that is entirely out of sight, the subject is harder to understand."

"You know we finished the other day by saying that the root fixes the plant to the soil and absorbs the food necessary for its growth and nourishment. It is the nature of roots to divide themselves into branches and spread beneath the ground. Roots are usually classified as fibrous, and fleshy roots. We shall examine some specimens of the different kinds and that will aid you in understanding.

"Here is the root of the Indian corn. It is a specimen of the fibrous root. Most of the annual and many of the perennial plants have fibrous roots. They serve only for absorption. If you will examine them, you

will see that they send out fine branches. Those branches are called rootlets. The whole surface of a root absorbs moisture from the soil while it is fresh and new. The newer the roots and rootlets, the more freely they absorb. As long as the plant grows above the ground and expands to fresh foliage, so long it continues to extend and multiply its roots in the soil beneath, which increases the surface for absorbing moisture, so as to supply the demand above. But when growth ceases above, and the leaves die and fall, as you saw in the bean plant, the roots generally stop growing and their soft and tender tips harden.

"That is why you will see persons transplanting trees and shrubs late in the fall or very early in the spring, before the leaves come. The absorbing surface of roots is much increased by the formation near their tips of root-hairs. They are delicate tubular outgrowths through the thin walls of which moisture is promptly imbibed.

"We have already spoken of the fleshy root of the turnip and carrot and how they become a store-house of nourishment. They are biennial plants, and the food created in the first season's vegetation is accumulated to be expanded the next season, in vigorous growth and rapid development of flowers, fruit and seed. After the

seed is matured the root dies, and with it the whole plant.

"Fleshy roots, Melba, may be single or multiple. The single root of the commoner biennial, is the tap-root which begins to thicken in the seed-bins. Names have been given to its shapes as follows: In the parsnip and carrot, when it thickens mostly at the crown or where it joins the stem, and tapers regularly downward to a point, it is called a conical-shaped root. When greatly thickened above, but abruptly becoming slender below, as you see in this turnip, it is called a turnip-shaped or nape-form root. When it is thickest in the middle, but tapers to both ends as it does in the common radish, it is called a spindle-shaped root. The roots mentioned are the first in importance, or the primary roots, as they are called. Next time, Melba, we will take up the secondary roots."

CONTINUATION OF THE TALK ON ROOTS.

"Well, Melba, we will go on with our lesson on roots today. Do you find it dry?"

"Why no, Miss Williams, I find it interesting, and I am glad to take up the subject again."

"Some of the secondary roots remain fibrous for absorption, while some thicken and store up food for the next season's growth. Let's look at this sweet potato plant. See, it is forming thickened roots. There in the middle they are just beginning to thicken. Look at this one; it is almost grown. These roots here are used for propagation by cuttings, for any part of it will produce adventitious buds and shoots from which plants will grow.

"Our next example is of the clustered root; the root of the dahlia. Look at each separate root. See, they are also spindle-shaped. They do not produce adventitious buds."

"How are they propagated, Miss Williams?"

"The buds by which the dahlias are propagated belong to the surviving base of the stem above the root."

"Oh, yes; I see."

"We will now talk on the irregular roots. They are a class of roots that subserve other uses than absorption, food storing and fixing the plant to the soil. They are aerial roots. They grow from stems in the open air; but not in all climates. They grow in warm, moist climates. Aerial rootlets are abundantly produced by many climbing plants, such as the ivy and trumpet creeper. They spring from the side of the stems and

are used by the plant for climbing and fastening itself to the trunks of trees, walls or other supports. There is another class of plants whose roots have no connection with the soil, but derive their sustenance from the air only. They are called air plants. They have aerial roots which do not reach the ground, but are used to fix the plant to the surface on which it grows, and they absorb moisture from the air. These plants grow on trunks of other plants.

"There is still another class, called parasite plants. Their roots grow in the tissue of other plants, or attach themselves to their surface so as to prey on their juices. The mistletoe belongs to this class of plants. The seed falls on the boughs and germinates there. The roots penetrate the bark and engraft themselves into the wood. They become as firmly united to the bark as a natural branch to its parent stem. Indeed, the parasite lives just as if it was a branch of the tree on which it grows and feeds. A common parasite herb is the dodder, which abounds in low grounds in summer. It coils its long, slender, leafless, yellow stems around the stalks of other plants. Wherever they touch they pierce the bark with minute short rootlets, which grow in the form of suckers. They draw out the nourishing juices of the plants on

which they lay hold. Other parasite plants, are the beech-drops and pine-sap. They fasten their roots under ground on the roots of neighboring plants and rob them of their juices. Some plants are only partly parasitic. While most of their roots act in the ordinary way, others make suckers at their tips which grow fast to the roots of other plants and rob them of their nourishment. Now, Melba, there are three facts that I want you to get from your study on roots. Can you tell me what they are?"

"Well, I must remember that the root fixes the plant to the soil, and that it absorbs moisture from the soil that enters the plant and is changed into vegetable matter on which it feeds and grows."

"Yes, and the roots become a store-house of food for both the animal world and mankind. Can you name some roots that are used for food?"

"Yes, the radish, carrot, turnip, beet, potato, parsnip, onion, horse-radish, tapioca, arrow-root and the root of the ginger plant."

"Yes, and the root of rhubarb plant, the ipecac and the sarsaparilla are used for medicine, and the root of the madder plant for coloring. The lesson is over now. Our next talk will be on stems.

TALK ON STEMS.

"The stem is the part of the plant, Melba, that bears all the other organs. It is the axis of the plant. At the very beginning it produces roots. As the root becomes a descending axis, so the stem that grows in the opposite is called the ascending one."

"Yes; I remember that from the lesson on the growth of the bean."

"The stem usually rises out of the soil and bears leaves. But there are forms of stems that remain underground, or make part of their growth there. These underground stems do not bear leaves and yet they bear the rudiments of them, or what answers for leaves, but they have not the form of foliage. The stems above the ground, through differences in duration, texture and size, form herbs, shrubs and trees. Those that die down to the ground, at the end of the growing season, as the clover, the mustard and common weeds, are herbs, or herbaceaus plants. When they are slightly woody below and survive from year to year, they are said to be suffrutescent. But if the lower stems are decidedly woody, though herbaceaus above, they are frutescent.

"Those that are woody and of consider-

able size and live from year to year are shrubs. When they are tree-like in appearance or mode of growth, or when they approach a tree in size, they are called arboreous. You must keep in mind the difference in growth and it will not be hard to remember the new names.

"Stems are also named according to the direction they take in growing. When loosely spreading in all directions, as they do in the branches of the syringa, they are called diffuse. When they turn or bend over to one side, like the stems of the weeping willow, they are called declining or drooping stems. When they recline on the ground as if too weak to stand, like the stems of the twin flower, they are called decumbent. When they lie flat on the ground from the first, as the stems of the garden nasturtium, they are called prostrate stems. When they are prostrate on, or just beneath the ground, striking root as they they grow along, as the stems of the white clover and the partridge-berry, they are called creeping stems. When they ascend by climbing to other objects for support, whether by tendrils, as in the pea, grape-vine, passion flower and Virginia creeper, or by their twisting leaf-stalks, as the Virgin's bower, or by rootlets like the ivy, poison ivy and the trumpet creeper, they are called climbing stems. When they coil

spirally around others stems or supports, like the morning glory and the hop, they are called twining stems.

"But the vast majority of plants, Melba, have their stems erect. They elevate the leaves and flowers in the most favorable position for receiving the influence of the light and air. We will not talk any more now, dear."

"Does that finish the subject, Miss Williams?"

"No, Melba, we will have to study the kinds of stems and their special uses yet. But this is all now."

THE TALK ON STEMS CONTINUED.

"There are certain kinds of stems or branches that have special uses and are named accordingly. Such as the stems of grasses, are called a culm. A branch that rises from an underground stem, is called a sucker. Stems of that kind are produced abundantly by the rose, the raspberry, and other plants that are said to multiply by the root. But if we uncover them we see at once the great difference there is between them and real roots. They are creeping-underground branches.

"The shoots, or plants that grow from those underground branches, become separate plants. The connecting stems either die off, or the gardener cuts them in two with his spade. That is the way he propagates or produces new plants."

"I never thought of that. I thought all plants came, as the bean plant does, from the seed."

"Yes, Melba, you would naturally think so until you learned differently. Other plants are produced by Stolons. They are branches that grow above the ground, but recline or become prostrate and take root where they rest on the soil. Thence they send off shoots, with roots of their own, that become independent plants after the connecting stems die, which they do, after a while. The current and goose-berry multiply that way. An off-set is a short stolon, or sucker, that has a crown of leaves at the end. The house-leek propagates abundantly that way.

"A runner is a long, slender, tendril-like stolon that is destitute of conspicuous leaves. The strawberry presents the most familiar example of it. After the runner has grown to its full length, it strikes root from the tip, which fixes it to the ground and forms a bud there. The bud develops into a tuft of leaves and so gives rise to a new plant which, of course, sends out

runners that act in the same way. In this manner, a single strawberry plant will spread over a large space, and in course of a growing season, produce a great number of plants, all of which were connected at first by slender runners that died after a while, leaving the plants as so many separate individuals."

"I am so glad to learn this, Miss Williams, for I can see our own strawberry patch increasing each year, but I supposed the plants grew from the seed."

"Tendrils are also branches, but of a very slender sort. They are like runners, but are not intended for propagation. They are only for climbing and are therefore destitute of buds or leaves. There are two kinds of tendrils—simple and compound. The passion-flower has simple tendrils. Compound or branching tendrils are borne by the cucumber-vine, the pumpkin-vine, the grape-vine and the Virginia creeper. A tendril generally grows straight until it reaches some support, then its apex hooks around it and takes hold. The whole tendril finally shortens itself by coiling up spirally and so draws the shoot of the growing plant nearer to the supporting object."

"What are tendrils, Miss Williams? Are they leaves?"

"Yes, some are leaves and some are only

parts of leaves. Those of the pea are leaves, while those of the ivy and the poison ivy are aerial rootlets. They are adapted to climbing roofs, walls, or tree trunks, to which ordinary tendrils are unable to cling. The nature of the tendril is known by the position it has on the plant. If it grows from the axil of a leaf, like that of the passion-flower, it is a stem or branch. And so it is, if it terminates a stem, as in the grape-vine. There are also stunted, or hardened stems called thorns, or spines."

"Yes, I see them on the trees."

"What kind of trees were they, dear?"

"Papa said they are honey-locust trees. Then I saw them on some blackberry and rose bushes."

"Oh, no dear, those on the blackberry and rose bushes are not leaves or branches, they are only an out-growth of the bark. Now remember, dear, they are not thorns."

THE TALK ON STEMS CONTINUED.

"We will now look at the underground stems, Melba. They are both numerous and various. They are commonly overlooked or else confounded with roots. That is because they are out of sight. But even

though they are, they will repay examination. The vegetation that is carried on underground is as varied and important as that above the ground. There are many forms, but they can all be referred to four principal kinds. The root-stalk or rhiyoma, the tuber, the corm or solid bulb, and the true bulb.

"The root-stock, or rhiyoma, is merely a creeping stem or branch growing beneath the surface of the soil, or partly covered by it. Of this kind, are the so-called creeping, running or scally roots. It is this kind of root by which a class of plants called the mint, the quick-grass and many others spread so rapidly. That these are really stems and not roots, is shown by their growth. They consist of a succession of joints, and bear leaves on their nodes in the form of small scales, just like the ones that grow on the upright stems above the ground. They also produce buds in the axils of those scales, that shows conclusively that the scales are real leaves; roots, you know, do not bear leaves or axillary buds. Although these stems are placed in the dark, damp soil, they naturally produce roots, just as the creeping stem does when it lies on the surface of the ground.

"Plants with these running shoot-stalks, Melba, take rapid possession of the soil.

They are always perennial plants. The underground shoots live over the first winter, and are provided with vigorous buds at every joint. Some of these buds grow in the spring into upright stems, bear foliage, and at length produce seed, while others form a new generation of underground shoots. This, of course, is repeated over and over again in the course of a season, or in succeeding years. As the underground shoots increase in number, the older ones that connect the successive growths, die off year by year, liberating the rooted side branches into so many separate plants.

"And so on they grow indefinitely. Cutting these running root-stalks into pieces only multiplies them, for each piece is already a plant-let with its roots and a bud in the axil of its scale-like leaf, with prepared nourishment enough to develop into a leafy stem. When the underground parts are only roots, if you cut away the stem, it completely destroys the plant. Root-stocks are usually thickened by storing up of nourishing matter in their tissues.

"The common garden iris has stout root-stocks which are only partly covered by the soil and which bears foliage leaves instead of mere scales. These leaves cover the upper part, while the lower produces roots. As the leaves die year by year, a scar is left in the form of a ring to mark

the spot where the leaf was attached. Some root-stocks are marked with large round scars of a different sort. There is one specimen of that kind called the Solomon's seal."

"Why do you suppose they gave it that name, Miss Williams?"

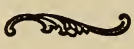
"Because the scar resembles the impression of a seal on wax. In the spring, the root-stalk sends up a herbaceaus stalk or stem that bears foliage and flowers, but they die in autumn. The seal is the circular scar left by the death and separation of the base of the stalk from the living root-stalk. As there is only one of these seals, or scars, formed each year, they mark the number of years it has produced stalks. Here is the root-stalk. Look at the scar. That bud that you see at the end of it, will grow next spring into the new stalk of the season and will die in the fall and leave a similar scar. As each year's growth of stem makes its own roots, it soon becomes independent of the older parts. After a certain age, a portion dies off behind, about as fast as it increases at the growing end, death following life with an equal certain step."

"Miss Williams, I think this is a beautiful lesson. I have learned so much."

"Are you tired now, dear?"

"Oh, no! I feel like I could listen a much longer time today."

"Yes, but I think we had better stop and take up the subject again.



ROOT STALKS.

"We shall continue our talk today, Melba. You remember we were on root-stalks, talking about the Solomon's seal. In vigorous plants, of the Solomon's seal, or iris, the living root-stalk is several inches or a foot in length. But in the short root-stalk of the trillium or birth-root, life is reduced to a narrow span. Here is a specimen of the trillium. When the root-stalk is short like this, it is called a caudex. When it is more shortened and thickened, it becomes a corm. A tuber is a part of a root-stalk thickened, and has buds or eyes on the sides. The Jerusalem artichoke, and the common potato are familiar examples of the tuber. Here, Melba, is a potato plant. See, the stalks by which the tubers are attached to the parent stem are different from the roots, both in appearance and in manner of growth. These scales on the tubers are rudiments of leaves and the eyes are the buds in their axils. The plant has three forms of branches. These that bear the ordinary leaves are expanded in the air.

They digest what they gather from it and also what the roots gather from the soil, and convert it all into nourishment. After a while this second set of branches that you see on the summit of the plants bear flowers which form fruit and seed out of a portion of this nourishment that the leaves have prepared, but a large part of the nourishment, while in a liquid state, is carried down the stems into the branches that grow under the ground. It accumulates there in the form of starch, at their extremities, and becomes tubers or depositories of prepared solid food. It is also true in the turnip, the carrot and the dahlia. The use of this storehouse can be plainly seen. In the fall the plant dies, but the seed and tubers live, although they are left disconnected in the ground.

"You learned, Melba, how a small portion of nourishment matter deposited in the seed feeds the embryo, when it is germinating, so the much larger portion, deposited in the tuber, nourishes its buds, or eyes, when they grow into new plants. The great supply of nourishment enables them to grow with great vigor and produce a great amount of vegetation which in turn prepares and stores up in the course of a few weeks, a large quantity of solid nourishing material. Man has taken advantage of it and the

potato is cultivated in almost every country for food.

"The corm or solid bulb is a very short, thick, fleshy, underground stem, often broader than it is high. Look at these. This is the corm of the Indian turnip, and this of the cyclamen. See the corm of the Indian turnip sends roots from its lower end and leaves and root-stalks from its upper. The corm of the cyclamen goes on and becomes more enlarged and produces a succession of flowers and leaves year after year. But the corm of the Indian turnip that is formed one year is consumed the next.

"Look at this corm, Melba. It is also the Indian turnip. This stage of its growth shows its development in the early part of the growing season. This naked part below here is the corm of last year, from which the root-stalks have fallen. It is partly consumed by the growth of the stems for the season. You can see the corm of the year, forming at the base of the stem above the line of roots.

"Here is the corm of the crocus. It is also reproduced annually, the new ones forming on the summit and sides of the old one. Let's look at the bulb. You see it is a stem just like a reduced corm. These thickened scales of which the body consists are leaves, or leaf bases. The bulb is a bud

with fleshy scales on an exceedingly short stem.

"This is the bulb of the white lilly. Compare it with these strong, scaly buds of the hickory and horse-chestnut and you will readily see the resemblance."

"Look at these; what are they, Miss Williams?"

"They are bulblets. See, they are very small bulbs that grew out of larger ones. They never grow into branches, but detach themselves when they are full grown, fall to the ground and take root there, to form new plants.

"Now we will talk on the shape of stems. All stems are not alike in shape. Some are four-angled, some fluted, some round, some three-sided, some acute angled, some five-sided, some square, some half round, and some compressed. There is also a difference in the color of the stem. The peach tree has red stems, the cherry, purple, the willow, yellow, some are spotted, some brown, some striped and some green. Some are smooth, some rough, some shiny, some dull, some hairy and some marked with dots. There is a difference in the taste and odor of the bark of the stems. The spice bush has a strong, fragrant odor and the papaw a fetid one, the sweet-birch an aromatic taste, and the peach a bitter one. The walnut has a strong scented, resinous,

aromatic bark and the slippery elm a mucilaginous one. Besides, you know, Melba, we use the following stems for food: The celery plant, the rhubarb, or pie-plant, the asparagus and the stem of the sago. The stems of the hemp plant and flax plant are used for manufacturing purposes, the branches and trunks of the logwood are used for coloring.

"Well, Melba, our long talk is over. We have tried to touch all the points that you wil need if you go on with the study of plants. The facts brought out you will have to know."

"What will we take next?"

"We will take up leaves."

"I know I shall like that."

"Yes, but you will find it long and somewhat tiresome maybe, but after awhile you will be glad you had the patience to go on."

"I am going to look for the things mentioned on stems, among the plants."

"Well, you do, and as you find them, make a note of them and bring your notes to class with you."

LEAVES.

Some time after the last talk, as Melba entered the class room, she exclaimed: "What a pile of leaves!"

"Yes," said her teacher. "We have quite a number. We are to begin our leaf talk today. We must learn a great many things about them, and therefore we will need plenty of them to look at and examine. Leaves play a very important part in the life of the plant, and you must know what it is before you can understand their function. They are the lungs of the plant. All the water taken in by the roots has to pass through the stems to the leaves, to be acted on by the air before it becomes vegetable-matter, and is fit to be used for the growth of the plant.

"There is something very beautiful about leaves that one would never notice were their attention not called to it. But the most important fact is, they exhibit an almost endless variety of form, and are classified and named according to their shapes, which is a great help in describing the plants on which they grow. Leaves, Melba, are so common that we seldom ever stop to consider their wonderful structure, perfect

arrangements, or great usefulness. But we should observe and study to know them, both by their shapes and names.

THE PARTS OF THE LEAF.

"A leaf with all its parts complete, has a blade, a petiole and a pair of stipules. This, Melba, is a leaf from the quince tree. Let us examine it. The flattened green part is the blade. This leaf stem is the petiole. These little leaves at the end of the petiole are the stipules. The top, or free end, as we say, is the apex. The lower, or attached end, is the base. The edge of the leaf is the margin, and the outside of the leaf is the surface. Some leaves haven't all the parts."

THE COMPOSITION OF THE LEAF.

"Leaves are composed of two kinds of material, woody fiber, and cellular tissue. The wood, or fibrous part, makes a frame-work of ribs and veins which gives the leaf more strength and toughness than it would otherwise have. The cellular tissue forms the green pulp of the leaf. It is spread over the frame-work both above and below and is supported by it. The whole is protected

by a transparent skin called the epidermis. The stoutest pieces of the frame-work which begins at the petiole and reaches across the blade are called ribs. When there is but one, as in this quince leaf, it is called a mid-rib. The branches of the mid-rib are called veins, and the branches of the veins are called veinlets. Look on your leaf and find them for me. That's right. Now, Melba, that finishes the talk for today. We will go on and finish up our talk on veins."

CONTINUATION OF TALK ON LEAVES.

"It is nature study today, Melba."

"Oh! Yes! Must I bring some leaves?"

"No never mind, for you don't know the kind of leaves to bring out what I want to teach today.

"Leaves are named according to their veins. When a leaf has a mid-rib that gives off veins right and left, making it look like a feather, it is called a feather-veined leaf. See if you can find one among the leaves. Do you know what kind of tree that leaf came from?"

"No, Miss Williams, I do not."

"It is the leaf from the peach tree. Find

other feather-veined leaves for me and I will name them for you. That is the lilac leaf, the elm leaf, the oleander leaf, the holly leaf, the quince leaf, and the weeping-willow leaf, and the leaf from the tulip tree. Put your peach leaf with them and your list will be complete. This, Melba, is a maple leaf."

"Yes, I knew that leaf, Miss Williams, because I see them all the time on the maple trees."

"When several veins pass across the blade in a spreading fashion as they do in the maple leaf, it is called palmate-veined. Whoever named that leaf, must have thought the ribs looked like the spread-out fingers branching from the palm of the hand.

"Find the palmate-veined leaves in this pile. This is right, it is the leaf from the scarlet geranum, the grape leaf, the English ivy, and the radish leaf. Put them together. Do you see any other leaves with veins that differ from the ones you have had?"

"Yes, here are the leaves from the grass."

"Yes, this is the yellow-lily and these are rose leaflets. You see their veins run side by side from the base of the leaf to the point of the blade. For that reason they are called parallel-veined leaves. That finishes our lesson for today."

"What will we take next time, Miss Williams."

"We will take simple and compound leaves."

"I don't know what those words mean,"

"No, but you will when you have had the lesson. You must go now. Your mama wants you to go with her this afternoon. Good-bye."

Melba enjoyed her trip with her mama and Mrs. Andrews was surprised to see how well her little girl had been instructed, and the amount of real information she had not only on plants, but the other studies that she was pursuing as well.

THE TALK ON LEAVES CONTINUED.

"We were to take up simple and compound leaves today. Leaves, Melba, are either simple or compound. They are simple when the blade is all of one piece and compound when made of a number of small leaflets. Can you show me a simple leaf?"

"Yes, all of those leaves we had before are simple."

"Yes, they are, but I would like you to name them."

I will, the lilac, the elm, the peach, the oleander, the holly, the quince, the weeping-

willow, the tulip tree, scarlet geranium, English ivy, radish, grass and lily leaves, are simple."

"That is good. Now, Melba, pick out the compound leaves and I will name them for you. The rose, ailanthus, wistaria, clover, American ivy, the horse-chestnut and the locust. You see that some compound leaves contain more leaflets than others. The rose has from three to seven, the ailanthus from twenty-one to forty-one; the wistaria eleven, the clover three, and the horse-chestnut seven. Some leaves have as many as eighty-one.

"Leaves are also designated by their apex, base, surface, petiole, blade, stipules, venation, margin and shape. I will describe these leaves for you, Melba. On account of their likeness in shape to other objects, they are given the name of that object. Now I am going to begin and you look and listen.

"This is the lilac leaf. . It has a sharp apex, a heart-shaped base, smooth surface, long petole, simple blade, no stiplues, feather-veined, entire margin and is heart-shaped. Now take each of the leaves that are on the desk, Melba, and go through with them as I did with the lilac leaf, and when you come to the place that you can't go on, I will help you."

"This is the elm leaf. It has a tapering apex, slanting base, rough surface, short

petiole, simple blade, small stipules feather-veined, a double-toothed margin and is egg-shaped."

"That is good. Go on."

"The peach leaf has a tapering apex, rounded base, smooth surface, short petiole, simple blade, no stipules, feather-veined, saw-tooth margin and is lance-shaped.

"The oleander leaf has a tapering apex, tapering base, a glassy or leather surface, no petiole, simple blade, is feather-veined, has a wavy margin and is oval in shape.

"The quince leaf has a sharp apex, sharp base, smooth surface, short petiole, simple blade, free stipules, is feather-veined, entire margin and is oval in shape.

"The leaf of the weeping-willow has a sharp apex sharp base, short petiole, smooth surface, simple blade, free stipules, feather-veined, finely toothed margin, and is narrow lance-shaped.

"The leaf of the tulip tree has a cut-off apex, heart-shaped base, smooth surface, long petiole, simple blade, no stipules, is feather-veined, two-lobed margin and is lobed-shaped.

"The leaf of the grape has a sharp apex, heart-shaped base, woolly surface, long petiole, simple bade, no stipues, palmate-veined, lobed margin, and is lobed-shaped.

"The leaf of the scarlet geranium has a round apex, kidney-shaped base, hairy,

sticky surface, long petiole, simple blade, no stipules, palmate-veined, doubled scalloped margin, and is kidney-shaped.

"The leaf of the English ivy has a sharp base, smooth, leathery surface, long petiole, simple blade, no stipules, palmate-veined, five-lobed margin, and is lobed-shaped.

"The leaf of the radish has a large, round apex, tapering base, rough surface, short petiole, simple blade, no stipules, is palmate-veined, lobed margin, and is lyre-shaped.

"The leaf of the grass has a sharp apex, sheathed base, smooth surface, no petiole, a simple blade, a scale-like stipule, is parallel-veined, entire margin and is sword-shaped.

"The leaf of the rose has a sharp apex, round base, smooth surface, very short petiole, simple blade, no stipules, feather-veined, saw-toothed margin, and is egg-shaped."

"That is very good, indeed."

"Yes, but you see you had to help me."

"Why of course I did at first, but you can describe them by yourself now."

"Yes, I am sure I can."

"Well, you may go now. The lesson is over."

COMPOUND LEAVES.

"What are we to have today, Miss Williams."

"Some more work on leaves; we are not through yet. We are to describe the compound leaves. Can you do it?"

"I can try."

"Well, I will help you. Take the ailanthus leaf. The ailanthus leaf is unequally feather-veined and has no stipules. That is the rachis, Melba, and the stem of the leaflet is the petiolule. The rachis of this leaf is long. It has petiolules and twenty-one leaflets. Take this one, Melba. This is the leaf of the rose. It is unequally feather-veined, the stipules are united to the rachis, the rachis is long, the petiolules are short, and the leaflets seven in number.

"Here are four other compound leaves."

"Must I describe them all?"

"Yes, Melba, for they are not alike, and I want you to see where they differ. Take this one."

"It is the leaf of the wistaria. It is unequally feather-veined, has no stipules, has a long rachis, very short petiolules and eleven leaflets.

"This is the clover leaf. It is three-

fingered, there are no stipules, no rachis, very short petiolules, and three leaflets.

"This is the leaf of the American ivy. It is five-fingered, has no stipules, no rachis, no petiolules, and but five leaflets.

"The leaf of the horse-chestnut is seven-fingered, has no stipules, no rachis, no petiolules and seven leaflets.

"That finishes the leaves, Miss Williams."

"Yes, and it is well done. This also finishes that part of the leaf subject. Our next talk will be on special leaves and their function. You may go now, dear. I am going riding."

"Must I bring some leaves?"

"Yes, you can. If you notice, Melba, the leaves are beginning to turn. Bring some bright-colored ones and we will decorate the school room with them."

SPECIAL LEAVES.

"Today we are going to give attention to the special leaves. A leaf may be so formed as to serve both an ordinary and a special use. We will first notice the leaves of storage. We will take the leaf of the common white lily, which springs from the bulb. It serves two purposes. The upper

green part serves for foliage and to elaborate nourishment, while the thickened portion, or bud scales beneath, serves for the storage of the nourishment. The thread-shaped leaf of the onion fulfils the same office. The nourishing matter it prepares is deposited in its sheathing base, and forms one of the layers of the onion. When those layers that are for a time so thick and succulent, have given up their store to the growing parts within they are left thin and dry. In the house-leek, the green color of the surface of the fleshy leaf indicates that it is doing the work of foliage, while the white portions, within, are the storehouse of nourishment which the green surface has elaborated.

"Seed leaves, or cotyledons, are also commonly used for storage. Those of the maple, the pea, the horse-chestnut and the oak are used for nothing else. In the beech and bean as you have learned, they are also principally used for storage. But in the pumpkin and the flax, the seed leaves serve for storage and then develop into the first foliage leaves. But after having fulfilled this purpose, and after the shoots develop and the foliage leaves appear, they fall off.

"Let's examine this spray from the low sweet buckeye. We can plainly see that it is a series of bud scales and foliage leaves. They have grown from a developing bud,

which shows nearly a complete gradation from a scale to a compound leaf of five leaflets. The scales also answer to reduced petioles. The lilac also shows a gradation from the bud-scale to simple leaf. In the flowering dogwood, the four bud-scales which through the winter protected the head of a forming flower, remains until blossoming, then the base of each grows out, into a large and very showy petal-like leaf. But the original dry scale is apparent in the notch at the apex.

"Leaves as spines occur in several plants. A familiar instance is that of the common barberry. In almost any of summer shoots most of the gradations may be seen between the ordinary leaves with sharp, bristly teeth and the leaves that are reduced to a branching spine or thorn."

"How do they know they are leaves, Miss Williams?"

"From the fact that they produce a leaf-bud in their axil.

"Leaves for climbing also vary in their adaptation. It is only true foliage leaves that serve this purpose. In the plant, gloriosa, the tip of a simple leaf hooks around a supporting object. In the solanum, jasminoides of our own garden, and in the plant called maurandia, the leaf-stalk coils around and clings to a support.

"In some compound leaves, as the pea and

most vetches, the lower leaflets serve for foliage, while some of the upper ones develop tendrils for climbing. Some plants have pitcher-shaped leaves. The pitchers are generally half full of water, in which flies and other insects are drowned."

"What becomes of them after they die in the pitcher?"

"They decay and enrich the plant. There are other plants of the same family whose leaves are especially adapted to the capture and destruction of flies and other insects. I brought the leaf of the napenthes for you to examine, Melba. It is constructed so as to combine three uses. This expanded part below is foliage. You see it tapers into a tendril for climbing. The tendril bears a pitcher. Insects are caught and digested in the pitcher."

"Why the plant has life almost like an animal, hasn't it?"

"Yes, there is a very close connection between plant and animal life, when we reach the lowest form of animals, but plants are always fixed to the ground. Now this is a plant called the Venus-fly-trap, which grows in the sandy bogs of the South. Its leaf also catches insects. It is the most extraordinary plant in this country. Each leaf bears at its summit an appendage, as you see, the shape of a steel trap, and operates much like one that opens and shuts.

When it is open, if a fly alights on its surface and touches one of these bristles that grow here, the trap suddenly closes and captures the intruder. It is then softened by a substance from a set of little glands that are on the inner surface and is digested."

"I am so glad to see this plant, Miss Williams, and have a description of it."

"Yes, it is indeed a curiosity. It is a member of the sundew family of plants. In other members of the same family, insects are caught by sticking fast to very viscid glands, situated at the tip of strong bristles. They are aided by other gland-tipped bristles that bend slowly together and secure the captive.

"Well, we have talked enough now and you must be excused."

"Oh! Miss Williams, I like this lesson on leaves so much."

"Yes, it is an interesting subject."

"What will we take next time?"

"We will finish up our talk on stipules and then we will leave the subject."

LEAVES CONTINUED.

"We will finish our talk on leaves today, Melba. The parts of a leaf is the blade, the petiole and a pair of stipules. But most

leaves have only minute stipules or none at all. Many have no petiole, the blade being cessile or stalkless. Some have no clear distinction between blade and petiole, and many of them, such as the leaves of the onion and the leaf-like bodies of the acacia plant, consists of petiole only.

"The base of the petiole is often broad and flat, and sometimes they are only thin margins. Again they are simple sheaths which embrace the stem at the point of attachment. Stipules are appendages that are wholly or partly separated from the petiole. When they are separate they are said to be free, as they are in the quince leaf. But when they are attached to the base of the petiole, as in the rose and clover they are adnate. When the two stipules unite and sheath the stem above the insertion, the sheath is called an acrea. In grasses, when the sheathing base of a leaf answers to a petiole and the summit of the sheath projects as a thin, short membrane. it is called a bigula.

"When the stipules are green and leaf-like, they act as foliage. In the pea they make a large part of the foliage and in the sweet-pea they make the whole of it, the remainder being a tendril. In many trees the stipules are the bud-scales. They are in the beech, the fig tree, tulip tree and magnolia. They fall off as the leaves unfold.

The spines or prickles in the locust and other pod-bearing trees and shrubs, are stipules. In the smilax or green-brier they are tendrils.

"We have now finished our talk on leaves, Melba, and you have learned a great many things about them. They are not only indispensable to the plant on which they grow, but are very useful in other ways. Many of them are used for food. Can you name some of those that are, Melba?"

"Yes, I think I can. The leaves from the cabbage plant, the lettuce, the spinach, beet-tops and mustard."

"Yes, and there are a great many plants that grow wild in some localities. Whose leaves are used for greens and salad. We also use the leaves from the tea, the sage, the thyme, the dock, the parsley, the water-cress and the mint. The leaves of the mul-berry are used to feed the silkworm, those of the indigo plant for coloring and those of the senna plant for medicine. Leaves are also used by insects, worms, birds and ani-mals for food, homes, shelter and shade. They not only serve their purpose as lungs of the plant, but they also adorn and decorate the plants. The leaves work very hard from the time they appear until autumn comes, then they are ready for a holiday. The mama plant tells them when it is time for them to leave their work, and

Mother Nature paints them up in beautiful colors. Some of them through the heat and dust of the summer have become rusty, dusty and soiled, but Mother Nature does not allow them to go that way. She dyes them a new bright color, so that they look like new leaves. They they say good-bye to the mama tree, or plant, and go for a visit to the seeds and plants on the ground below. Jack Frost turns them brown and then they go to sleep."

"What becomes of them then, Miss Williams?"

"They decay and by the action of the wind, water and air, they are changed into soil."

"Oh, yes, I see! They go back to earth again to be changed into vegetable matter by other plants."

"That is true, Melba. I see you have the right idea."

"What time do the leaves usually leave the trees?"

"That depends upon the locality and climate, but in the temperate climate, they fall in October.

"Here are some verses, Melba. I want you to commit them to memory."

"Did you compose them, Miss Williams?"

"Oh! no dear. I don't know who the author of them is, but they are pretty and speak of the leaves falling from the trees.

"October gave a party,
The Leaves by hundreds came,
The Ashes, Oaks and Maples
And those of every name.

"The Sunshine spread a carpet,
And everything was grand,
Miss Weather led the dances,
Professor Wind the band.

"The Chestnuts came in yellow,
The Oaks in crimson dressed,
The Lovely Misses Maple
In scarlet looked their best.

"All balanced to their partners,
And gaily fluttered by;
The sight was like a rainbow,
New fallen from the sky.

"Then, in the rustic billows,
At hide and seek they played,
The party closed at sundown,
And every body stayed.

"Professor Wind played louder,
They flew along the ground,
And here the party ended,
In jolly all hands round."

THE TALK ON FLOWERS.

"Well, Melba, we are to begin our talk on the flower today. I hope you will be interested, for they are the most interesting part of the plant."

"Oh, yes, I shall be interested, Miss Williams, for I admire flowers so much; they are so beautiful. I never get tired of having them around and since I have been studying plants they seem more beautiful than ever."

"Yes, they are beautiful and we do admire their lovely forms and colors, but never think of the exquisite arrangement of their parts and the wonderful variety they exhibit therein.

"We do not understand the work they perform and how wonderfully adapted they are to do it.

"The subject is a very extensive one, but we will take our time and make it as simple as possible. I am sure you will be able to grasp it.

"Flowers, like leaves, have been created to serve a purpose. They are for the production of seed only. Stems and branches on all kinds of plants, when they put forth leaves for vegetation, also put forth flowers for reproduction. You learned that leaves

and branches are arranged in regular order on the stem and are named from their position. So the flowers are also arranged in regular order on the plants that bear them. That arrangement, Melba, is called their inflorescence. Flower buds appear where leaf buds do. They are either terminal or axillary. Flowers are found to answer to shoots, or branches, and their parts to leaves."

"Why, Miss Williams, I never would have thought of that!"

"No, dear, only those who make plant-life a study know that to be a fact. But it is true. Our talk today will be on the kinds of inflorescence.

"There are two kinds, indeterminate or indefinite and determinate.

"The indeterminate or indefinite, inflorescence is so named because the flowers of this class comes from axillary buds only. In that case the terminal bud may keep on growing and therefore prolong the stem indefinitely. Let's examine this spray. It is from the stem of the flowering money-wort. You see the flowers are single and are successfully produced in the axil of the leaves from below upward as the stem grows on. When flowers grow singly from the axils of leaves, they are axillary and solitary. That is, they are not collected in flower clusters.

"When several or many flowers are produced near each other, the leaves that grow with them are smaller and of a different shape and character from the ordinary leaf. Such leaves are called bracts, and the flowers thus brought together, form a flower cluster.

"The kinds of flower clusters of the indeterminate class have been given distinct names according to their form and disposition. They are the raceme, corymb, umbel, spike, head, spadix, catkin and panicle."

"I don't think I can remember those names, Miss Williams."

"I think you can after you have had a description of the flower cluster, and the name becomes associated with the flower."

"Oh! I see."

"If a flower has no stalk and sits directly in the axil, it is said to be sessile. But if it is raised on a naked stalk of its own, as it is in the money-wort spray, it is said to be pedunculate, and the stalk is a peduncle. A peduncle on which a cluster is raised is called a common peduncle, and that which supports each separate flower of the cluster is a partial peduncle, or pedicel."

"Well, Miss Williams, I understand that."

"Oh, yes, Melba, you will not find it hard if you are attentive. That portion of the general stalk along which the flowers grow,

is called the axis of inflorescence, but when covered with sessile flowers, it is called the rhachis. The leaves of the flower cluster are generally termed bracts, but when the different orders are distinguished, those on the common peduncle that have a flower in their axil keep the name of bracts, while those on the pedicel are called bractlets. A raceme is that form of flower cluster in which the flowers, each on its own stalk or pedical, are arranged along the side of a common stalk.

"Here are some specimens of the arrangement. This is the cluster from the Lily of the Valley, this is the Currant and this the Barberry. You see each flower comes from the axil of a small leaf or bract which, however, is so very small that it might escape notice. Sometimes they disappear altogether, as you see they have in this spray from the mustard plant. See, they are entirely absent.

"Another thing, Melba, you see that the lowest blossoms of a raceme are the oldest, and therefore they open first. The order of blooming is from the bottom to top. The summit that is never stopped by a terminal flower may grow on, and often does. This plant is called the Shepherd's Purse. It produces lateral flowers one after another for many weeks.

"A corymb is the same as a raceme, except

that it has a broad, flat top. The raceme becomes a corymb by the lengthening of the lower pedicels, while the upper ones remain shorter. I had a time getting a specimen of that arrangement, but I did at last. It is a cluster from the hawthorn. Look at it, Melba. I think it is a very pretty cluster."

"Yes, they are all very beautiful."

"An umbel is a cluster in which the pedicels all spring from the same level, like the ribs of an umbrella, from which it takes its name. The Milkweed plant and the Primrose bear their flowers in umbels, and the pedicels in the umbels are sometimes called rays. When the bracts are brought into a cluster, or circle, they form what is called an involucre.

"We will stop now, Melba, and you may go for your recreation."

Melba enjoyed her outing, for the winter and spring had passed and the flowers were all in bloom and she had an opportunity to see many of the arrangements she had been studying.

FLOWERS CONTINUED.

"We are to go on with our nature lesson today, dear."

"What are we to have, Miss Williams?"

"We are to finish up our talk on indeterminate inflorescence.

"A head is a round cluster of flowers which are sessile, on a very short axis. The red clover, bachelor's-buttons, the dandelion, thistle and buttom-bush, are good examples of the head."

"I see them all the time, Miss Williams, and I will remember that their flowers are arranged in heads and will look for others that have the same arrangement."

"Yes, you must, dear. The head of the Buttom-bush is naked, but the head of the Thistle, the Dandelion and any other heads like them, are surrounded by empty bracts which forms an involucre. A spike is a flower cluster, with a more or less lengthened axis, along which the flowers grow, that are sessile, or nearly so, as they are in the Plantain and Mullein blossoms. There are two forms of the spike and the head, that have received particular names; the spadix and the catkin.

"A spadix is a fleshy spike or head, with small and often imperfect flowers, as in the callo, the Indian turnip and the sweet flag. It is commonly surrounded or embraced by a peculiar enveloping leaf called a spathe.

"A catkin is the name given to the scally sort of spike of the birch, the alder, the willow, the poplar, and one sort of flower cluster of the oak and the hickory. Any of the flowers mentioned may have compound flower clusters. I mean, that there

may be racemes clustered in racemes, corymbs in corymbs, and umbels in umbels. The blossoms from the parsnip, the caraway, the parsley, and nearly all the great family of umbelliferous plants have that flower arrangement.

"A panicle, is an irregularly branching compound flower cluster, of a more or less open sort, such as is seen in the blossoms of the oats and many grasses.

"We have now finished the subject of indeterminate inflorescence, and when our Nature Study hour comes again, we will take up the subject of determinate inflorescence. You must go for your ride now, the carriage is waiting and some one is calling you."

Oh, it is mama! Good-bye, Miss Williams, I wish you were going, too."

"Well, I will some time, dear."

Melba enjoyed her ride so much; she always did when her mama accompanied her. As Melba drove through the forest and beheld the beauties of nature, she exclaimed: "What a wonderful being, Mother Nature is to have so many wonderful things and to have them in such order.

DETERMINATE INFLORESCENCE.

"Determinate Inflorescence is that in which the flowers grow from terminal buds, Melba. The simplest case, is that of a solitary terminal flower which stops the growth of the stem, for its terminal bud becoming a blossom can no more lengthen in the manner of a leaf bud.

"Any further growth must be from axillary buds, developing into branches. If such branches are leafy shoots, they at length terminate by single blossoms, the inflorescence still consisting of solitary flowers at the summit of the stem and branches.

"But if the flowering branches bear only bracts, in place of ordinary leaves, the result is the kind of flower cluster called a cyme. This is commonly a flat-topped flower cluster, like a corymb, only the blossoms are from terminal buds. Look at this spray from the rose. This is the simplest form of that arrangement, or the simplest cyme. See, it has opposite leaves and three flowers. The middle flower terminates the stem, and the two others terminate branches. There is one flower from the axil of each of the uppermost leaves. They blossom later than

the middle one. The flowering, therefore, proceeds from the center outward. That is opposite the indeterminate mode, or where all the flower buds are axillary. The elder, and the hydrangea are examples of this arrangement.

"The third class is the mixed inflorescence. In that class the two arrangements that have been mentioned are combined or mixed. The lilac and the horse-chestnut blossoms afford common examples of mixed inflorescence. When they are loose and open flower clusters, they are called by the general name of panicles."

"How will I know the difference in the inflorescence, Miss Williams?"

"By closely observing the plants, Melba, when they are in bloom, you can see the different kinds of inflorescence. We have now completed our talk on the arrangement of the flowers on the plants. We will next take the parts of the flowers.

"The blossom shows the character of the plant and the family to which it belongs. It is therefore very necessary to study not only the flower and its arrangement on the plant, but the parts that compose the flower. We must learn those parts that are necessary to seed-bearing. They are the essential organs, the stamens and pistils."

"Are they the only organs that the flower has?"

"Oh, no, but the other organs serve for protection or attraction, often for both. Such are the leaves of the flowers or the floral envelopes. The floral envelopes are the outer circle of the flower, called the calyx and the inner circle called the corolla.

"The calyx is commonly a circle of green leaves, but not always. It may be the most brightly colored part of the blossom. Each calyx leaf or piece of the calyx, is called a sepal. The corolla is the inner circle of the floral envelopes, or flower leaves. Each corolla leaf is called a petal. Look at this apple blossom; can you show me the calyx? That is right, and the corolla? Yes, a sepal and a petal. That is pretty good, Melba.

"There are many flowers that consist wholly of floral envelopes. The full double flowers of which the choicer roses, peonies, dahlias and chrysanthemums are familiar examples. In their cultivation the petals have taken the place of both stamens and pistils. They are large flowers and incapable of producing seed."

"Oh! I see."

"The common name, Melba, of double flowers is not a sensible one. It would be better to call them full flowers, because they are full of leaves. The essential organs of the flowers are also of two kinds. They are placed one above or within the other. First, the stamens or fertilizing organs, and

second, the pistils that are to be fertilized, and then to bear the seeds.

"Here, Melba, is a stamen. You can see it consists of two parts: this part is the filament or stalk, and this is the anther."

"Oh, yes, I see."

"The anther is the only essential part. It is a case and usually has two lobes or cells. At the proper time they open lengthwise by a slit and discharge a powder or dust-like substance, usualy of a yellow color. That powder is the pollen, or fertilizing matter. It is the work of the stamens to produce this powder. This is the pistil. It is the body in which the seeds are formed. They belong in the center of the flower. This enlarged part at the bottom is the ovary, which becomes the seed-vessel. This tapering portion that is prolonged upward into a slender stem-like body, is the style. This tip at the top of the style is the stigma.

"This is the flower of the lily, Melba. I took it because all of the parts are on a large scale and can be easily seen. Let's cut the ovary through. What do you see, dear?"

"Some young seeds."

"Yes, these young seeds are called ovules. Pull the flower leaves and stamens away. What is left?"

"The end of the flower stalk."

"Yes, that is the receptacle or stem out of

which the organs of the flower grew, or on which they are borne. The parts of the flower, Melba, are all placed in regular order. First, the sepals, or outer flower leaves; second, the petals, or inner flower leaves; then the stamens, and last, the pistils. They are all the parts of the flower. We will next take the plan of flower formation.

"All flowers, Melba, are formed on one general plan, but with almost infinite variation. The common plan can be best understood, dear, by taking for a type a perfect flower. A blossom that is complete, regular and symmetrical. I know you do not understand any of that now, but you will understand it, when it has been explained.

"A perfect flower has both kinds of essential organs; that is both stamens and pistils. It is complete when besides the essential organs, it has two sets of floral envelopes, calyx and corolla; regular, when all the parts of each set are alike in shape and size; and symmetrical, when there are any equal number of parts in each set or circle of organs.

There is still another flower arrangement called the numerical plan.

"In this there is a certain number that runs through the flower or can be seen in some of its parts. The number is either three or five. The examples of the arrange-

ment by threes is found in the trillium, the tulip, the lily, the crocus and the iris. The example of the arrangement by five is seen in the three-leaved stone-crop. In these same flowers can be seen the alternation of the successive circles. We mean by that expression, that in the flowers under the numerical plan, the parts of the successive circles alternate. In the arrangement, the petals stand over the intervals between the sepals. When the stamens are of the same number they stand over the intervals between the petals. But when they are twice as many as they are in the trillium, the outer set alternates with the petals and the inner set stands before the sepals and alternates with the pistils. This is just as it should be, if we are to understand that the circle of blossoms answer to whorls of leaves, that alternate."

"Do they answer to whorl of leaves, Miss Williams?"

"Some who know a great deal more about plants than I do, dear, say they do. It is said by these same authorities that flowers are altered branches, and their parts, altered leaves. They teach that buds which might have grown and lengthened into leafy branches, developed into blossoms. In them the axis remains short, as it is in the bud, and the leaves remain close together in sets or circles. The outer ones, or those of the

calyx, generally partake more or less of the character of foliage, but the next set are more delicate, and form the corolla. The stamens and pistils appear under very different forms, from those of ordinary leaves. They are concerned in the production of seed."

"Why do some suppose that flowers answer to branches, Miss Williams?"

"By their position on the plant. You remember in our talk on inflorescence, we learned that flowers grow from the same places that branches do, and from no other. Flower buds, like leaf buds, appear either on the summit of a stem, as a terminal bud, or in the axil of a leaf, as an axillary bud. Besides the plan of a symmetrical flower shows the same arrangement of its parts on its axis, as the leaf on its stem. The petals have the nature of leaves, and are called the leaves of the flower."

"Oh! yes, now I understand."

"You see, the calyx is most always green in color and leaf-like in texture. The corolla is not green, but neither are all the leaves green. The leaves of the wild painted-cup are as bright colored as the corolla itself. The leaves of the scarlet sage are also red. These two instances prove that leaves are not always green. If you could examine the flowers of the cactus, the Carolina all-spice, and the white water lily,

you would find it difficult to tell where the leaves of the plant end and the calyx of the flower begins. If sepals are leaves, so are petals, for there is no fixed limit between them. The water lily has more than one row of petals, but there is such a complete transition between the calyx and corolla, that no one can tell how many of the leaves belong to the one, and how many to the other.

"The stamens are of the same nature as the petals, and are therefore a modification of leaves also. There is a gradual transition from the one to the other in many blossoms, especially in such as roses and camellias when they begin to double. In such cases, their stamens change to petals. The Carolina all-spice and white water lily exhibit gradations, not only between their petals and sepals, but also between their petals and stamens. The sepals are green outside, but white and petal-like on the inside.

"Again the petals in many of the rows gradually grow narrower to the center of the flower. Some are tipped with a trace of a yellow anther, while others are more stamen-like, but have flat, petal-like filaments, and if we would continue our observations, we would see that the last row are genuine stamens."

"Miss Williams, do pistils and stamens ever change into each other?"

"Yes, they do, but not often. The change has been noticed in some willows. Pistils often change to petals in some cultivated plants, and sometimes a blossom changes to a cluster of green leaves, or degenerates into a leafy branch. Now, Melba, we have finished this part of the subject. We will now look at some of the flowers that deviate from the type or pattern flower and how they differ from the natural pattern.

"The deviations are various and extensive. They embrace the imperfect flowers, many of which have neither stamens or pistils. The perfect flowers are called the hermaphrodites. They have both pistils and stamens. When flowers have stamens and not pistils, or pistils and not stamens, they are called unisexual flowers. Sometimes flowers of both sorts are produced by the same plant. When they are, they are called monoicous flowers. That word means they are of one household.

"An example of this flower can be seen in the castor-oil plant. When the two kinds of flowers are borne on different plants, as they are in the willow, poplars, hemp, and moon-seed plant, they are called diocoious, meaning they are flowers of separate households. When some of the flowers are perfect, or hermaphrodite, and some staminate

or pistillate only, they are said to be polygamous.

"A blossom that has stamens, but no pistils, and a blossom having pistils but no stamen, is a pistillate or female flower. Incomplete flowers are so named in contradistinction to complete ones. They have but one floral envelope, and sometimes none. The flowers of the castor-oil plant are incomplete, because they have a calyx, but no corolla. The Pennsylvania anemone has a corolla-like calyx, and the flower of the saururus, or lizard's-tail has neither calyx or corolla and still it is a perfect flower. Incompete flowers are said to be naked, because they are destitute of both floral envelopes and is apetalous."

"When they have no corolla, Miss Williams, do flowers ever have a corolla and no calyx?"

"Not often, dear, but there are instances where they do. Usually where there is a single perianth, it is taken to be a calyx, unless the absent calyx can be made evident. In contradistinction to regular and symmetrical flowers, many are also irregular and unsymmetrical. They are irregular when they have all or some members of the floral circles, unequal or dissimilar, and unsymmetrical, when the circles of the flowers or some of them differ in the number of their members, but want of symmetry

and irregularity usually go together. Both kinds are common, for there are few flowers that are entirely symmetrical beyond the calyx, corolla, and perhaps the stamens."

"How are we to know those things," Miss Williams?"

"Only by observation. If you should examine the mustard blossom you will see it has four equal petals, four equal sepals, one pistil and six stamens. There are two circles. The outer one has two stamens and the inner one has four. The violet blossom is on the plan of five. It is symmetrical in calyx, corolla and stamens, because each of the circles consists of five members. The corolla is irregular because one of the petals is different in shape from the rest of the other parts.

"Take the flower of the larkspur and monks-hood or aconite. They are related. They have an irregular calyx and corolla and are very unsymmetrical. The irregular calyx consists of five sepals, one of which is larger than the others, and is prolonged behind into a large soc, or spur. But the corolla has only four petals that are of two shapes. The fifth is left out. The monks-hood has five very dissimilar sepals, and a corolla of two very small and curiously shaped petals. In that case, there are three parts needed to make up the symmetry. In these flowers the stamens and pistils are

also out of symmetry. They are usually diminished to three, two and some times to one. We will not go any farther today, Melba. You have done well, to be so attentive, for this is a difficult subject."

FLOWERS CONTINUED.

"We are to go on with our flower talk today, Melba. There are a great many flowers that have a multiplication of parts. Take those flowers that we had the other day and you will find they have an indefinite number of stamens, but not so many pistils. Most cactus flowers and water-lilies have the number of their organs much increased. The buttercup has five sepals and five petals, but an indefinite number of both pistils and stamens.

"Flowers are also modified by the union of their parts. In such cases the parts look like separate leaves or other organs growing out of the end of the stem, or receptacle. There are two kinds of such union. The blossom from the stramonium, or jimson weed, has five petals and five sepals. They are united to their tips, which causes them to form a tube or long, narrow cup. When the parts of the same circle are united as in that flower, it is called coalescence. There is also a union of unlike parts, called adnation. We will have an example of it later.

"There are certain needful terms that express the union of these parts that will have to be used in talking about them.

When the petals of a corolla coales into one body, whether at the base or higher; for the union may extend to the very summit, as it does in the bloom of the morning-glory it is a gamopetalous or monopetalous corolla. Monopetalous means one petaled; while the word gamopetalous means united petals. Polypetalous is a term that denotes separate or many petals. There is a degree of union, or separation in the corollas and calyxes, that must have some consideration before we leave the subject.

"A corolla when gamopetalous commonly shows a distinction by a well-marked tubular portion below, called the tube, and a spreading part above, called the border or limb. The enlarged upper portion of the tube between the two is called the throat. The same names are used for the parts of the calyx. There are also names given to particular forms of the gamopetalous corolla that also apply to the gamopetalous calyx. When it spreads out at once, having no tube, or a very short one, ssuming the shape, it is said to be wheel-shaped, or rotate. The potato blossom with its five-lobed corolla, and the five-parted corolla of the bitter-sweet, are both wheel-shaped."

"Miss Williams, I can get them. For they are growing in our garden."

"Yes, any time when the plants are near, examine them."

"When the corolla has a flat, spreading border that is raised on a narrow tube from which it diverges at right angles, as it does in the flower of the standing cypress or ipomea and of the phlox, it is said to be salver-shaped. Where the flower has a short, broad tube that widens upwards, assuming the shape of a bell, as the blossom of the campanula, or hare-bell does, it is said to be bell-shaped. When the corolla gradually spreads from the summit of a tube, as it does in the blossom of the jimson weed and morning-glory, they are said to be funnel-shaped. And when the corolla is prolonged to a tube, with little or no spreading of the border, as in the flower of the trumpet honey-suckle, and the calyx of the jimson weed, it is said to be tubular in form.

"Another thing, Melba, although the sepals and petals are usually all blade, like a sessile leaf, yet they may have a contracted stalk-like base that answers to a petiole. That part of the flower-leaf is called the claw. The flowers of the Pink family are strongly marked with the claw. The polypetalous corolla of the soap wort has five petals with long claws or stalk-like bases. Such petals may also have an outgrowth or extension of the inner face, called the crown. The crown grows into an appendage or fringe, as you can see in the blossom of the soap-wort, and in the petal of the silence.

"The last named flower has a two-parted crown that consists of numerous threads on the base of each petal. Irregular flowers may be polypetalous, or nearly so, as they are in the blossom of the locust. It has a papilionaceous corolla. That flower takes its name from its shape. The word means butterfly-like."

"Do you think it looks like a butterfly, Miss Williams?"

"Well, dear, if the flower is large and of a brilliant color, it may be somewhat suggestive. There are many plants with that shaped blossom, as you will learn when you begin to take them by families. The flower is nearly polypetalous, but not entirely so, because two of the petals slightly cohere. If you take the flower apart you can see the petals much better It has a large upper petal, called the standard, or banner, and two sides ones that are quite different in shape from the standard. They are called the wings. There are two smaller ones than the others that are slightly coalescent. They are called the keel.

"The flower of the dead nettle also has a peculiar shaped corolla. It is called the labiate corolla. Labiate means two-lipped, but the word should have been bilabiate. That word more nearly expresses the meaning. The flower from the snap-dragon is also two-lipped, and so is the bloom from the

toad-flax, but the corolla of that flower is spurred at the base. These flowers are all on the plan of five. The irregularity in the corolla is owing to the unequal union of the petals, as well as to the diversity of their form. In the dead-nettle bloom, the two petals of the upper side of the flower unite with each other higher up than they do with the side petals and there form the upper lip. The side and lower petals unite in a similar manner to form the lower lip. The lobe which is generally found at the summit of the lower lip shows its real formation.

"The five parts that we have described, alternate with those of the calyx outside of them. But when the calyx is also bilabiate, as they are in the blossom of the sage, the alternation gives three lobes to the upper and two to the lower lip. Therefore, Melba, the two forms of the bilabiate corolla have been designated by certain names. When the orifice is wide open as it is in the blossom from the dead-nettle, it is said to be gaping, or ringent. But when an intrusion of the base of the lower lip, called the palate, projects over or closes the orifice, as it does in the snap-dragon and toad-flax, it is said to be personate, or masked.

"There are certain gradations between the bilabiate and regular corollas that I would like you to see. In the Gerardia and

and Catalpa, the bilabiate character is slight, but is manifest on close inspection. But in all such flowers, the plan of five can be seen in the calyx and corolla, but obscured in the stamens by the abortion, or suppression of one or three of their number. In the corolla of the purple gerardia there are four stamens, but a vacant space in the center of those present, where the fifth one would be, if it were present. The corolla of the pentstemon has four stamens and a sterile filament in the place where the fifth one would be, and in the corolla of the catalpa there are two fully developed stamens and three abortive ones. You may go now, Melba."

"What will we take next time?"

"We will examine the strap-shaped, or lingulate corolla, and then leave the subject."

Melba thought of the many things she had learned, and as she went out, she said to her maid: "Come with me, Mary, I am going to the flower garden this afternoon to look at some of the flowers I have been talking about." She went to the snapdragons and larkspurs and said to them: "I have come to look at your pretty and curiously shaped corollas. We have been talking about you."

FLOWERS CONTINUED.

"We will now examine the strap-shaped, or lingulate corolla today, Melba, and then leave the subject. That shape mainly belongs, or is found in the flowers of the Composite Family, where numerous small flowers form a head within an involucre that imitates a calyx.

"The best examples of that corolla are the dandelion and chicory blossoms. Each one of the shapes look like so many petals, but they are the corolla of a distinct flower. The base of the flower is a short tube that opens out into the lingule. It has five minute teeth at the end, which indicate the number of petals. It is a kind of gamopetalous corolla that opens along one side nearly to the base, then it spreads out. In asters, daisies, sunflowers, coreopsis and the like, only the marginal or ray corollas, are lingulate, but those of the disk are regularly gamopetalous, tubular in shape, and five-lobed at the summit. But they are small and inconspicuous, only the ray flowers making any show. In fact those of the coreopsis and sunflower are simply for show, being not only sterile, but neutral."

"What does that mean, Miss Wiliams?"

"That they have neither pistils or stamens."

"Oh, yes, I see."

"But in the asters, daisies, golden-rod and like flowers, the ray flowers are pistilalte and fertile. They therefore serve for seed bearing as well as for show.

"That finishes that subject, Melba, and we will now look at the union that is found to exist between the parts that belong to the different circles of the flower.

"The union of the parts is called adnation. The parts of the flower are not formed and then joined, but they are produced in the union. That is, they are borne united. There is no adnation in the flax flower. The sepals and stamens are all separately borne on the receptacle, one circle within or above the other. But the five pistils have their ovaries coalescent. In the cherry blossom the petals and stamens are borne on the throat of the calyx tube, the sepals are coalescent into a cup, and the petals and stamens are adnate to the inner face of it. In the purslane flower the same parts are adnate to or consolidated with the ovary up to its middle. In the hawthorne flower the consolidation has extended over the whole ovary and the petals and stamens are adnate to the calyx, still further up. It is the same in the cranberry blossom, except that all the

parts are free at the same height and all seem to rise from the top of the ovary.

"Our next step now, dear, will be to notice the arrangement of the parts of the flower in the bud before the blossom opens. But we will not begin the subject today."

"I never would have thought that there was so much to be learned about flowers. How wonderfully complicated they are in their structure! But I am beginning to see now, Miss Williams, why you said to me that I could not take the plants by their families until I studied the parts of the plant."

"I am glad you remember that, dear, for since you do, you can see what I had in mind when I told you that."

NATURE STUDY

"It is Nature Study today, Melba, and we are to begin our new subject. There is nothing in all the works of nature but what are done in an orderly, systematic way, and like everything else, the parts of the flower in the bud have a perfect arrangement and have been studied and known. It is called the estivation of the flower. The leaves of the calyx or corolla either over-lap each other in the bud, or they do not. When they do not, they meet each other by their edges, then the estivation is said to be valvate. That arrangement is found in the calyx of the linden or basswood. When the margins of each piece projects inward, as they do in the calyx of the virgin's bower, it is an induplicate estivation. When the margins are rolled inward as in the clematis it is involute. When the parts do not touch, as in the bud of the mignonette, it is reduplicate. When they are twisted or rolled together as they are in the corolla of the flax flower, they are convolute. When folded lengthwise and the plaits turned outward, forming projecting ridges, as in the campanula, or turned inward, as in the gentian, it is said to be plaited or plicate.

But when the plaits are convolutely wrapped round each other, as in the morning-glory and jimson weed, it is supervolute estivation.

"You remember, dear, that the arrangement is not confined to just the flower buds of the plants named, but runs through the buds of all the plants of the family to which that plant belongs. The valvate is the estivation that marks all the plants that belong to the same family that the linden or basswood belongs, and so on with all the arrangements.

"At our next talk, we will take the stamens and pistils."

"Why, Miss Williams, I thought we had finished with them."

"Oh, no dear, we haven't even touched that subject yet."

STAMENS AND PISTILS.

"We are to begin our new subject today, Melba. The stamen of a flower usually goes with the petals. There are several forms of insertion or attachment. In some they are inserted on the corolla, near the base, as they are in the corolla of the morning-glory.

In the flower called the lady's-slipper and other members of the orchid family, the stamens are inserted on the style.

"The number of stamens differ in different plants and they run from one to many. The filament is a kind of stalk to the anther. It is commonly slender or thread-like, and is to the anther, what the petiole is to the blade of a leaf. It is therefore not an essential part, for the anther may be sessile. The anther is the essential part of the stamen and is a sort of case filled with a fine powder called the pollen."

"Yes, I know we had that before, and I remember it."

This pollen fertilizes the pistil so that it may produce perfect seeds. Very seldom does a stamen bear any resemblance whatever to a leaf, or even a petal or flower leaf. Nevertheless, many who have made plant life a special study, see that the stamen answers to a leaf that has developed in a special form, and for a special purpose. In the filament, they see the stalk of the leaf, and in the anther the blade. The leaf blade consists of two similar sides and the anther consists of two lobes, or cells, one answering to the left and the other to the right side of the blade. The two lobes are often connected by the prolongation of the filament which answers to the midrib of the leaf. The arrangement is seen in the stamens of

the isopyrum. In it the connective, is so broad that it separates the two cells of the anther to some distance.

"The pollen is a powdery matter, commonly of a yellow color, which fills the cells of the anther and is discharged during the blooming time. After it is discharged the stamen generally falls or withers away.

"The next part of the flower to consider is the pistil. When there is only one pistil it occupies the center of the flower; but when there are two they stand facing each other in the center of the flower. Where there are several they commonly form a ring or circle, and when they are numerous they are generally crowded in rows or spirals on the surface of the receptacle. The parts of a complete flower, as already explained are the ovary, style and stigma. The ovary is one essential part, because it contains the rudiments of the seeds, called ovules. The stigma, that is situated at the summit, is also essential. It receives the pollen which fertilizes the ovules, so that they may become seeds. But the style, that is commonly a tapering, or slender column, borne on the summit of the ovary, bearing the stigma on its apex, or side, is no more essential to the pistil than the filament is to the stamen. Therefore, there is no style in many pistils. The stigma is sessile and rests directly on the ovary in those plants where it is

absent, as it does in the pistil of the mandrake or May-apple.

"The stigma varies in shape and appearance. Sometimes it is a little knob, as it is in the cherry blossom, or a point, as in the spider wort. Sometimes it is a crest, or line, as in the isopyrum, or it may occupy the whole length of the style as it does in the pistil of the sand wort.

"Well, now, you may be excused, Melba. We will take up the simple and compound pistil next time we talk.

"This has been an interesting talk, Miss Williams."

"I am glad you liked it dear."

SIMPLE AND COMPOUND PISTILS.

"We are to take the simple and compound pistil, today, Melba. A pistil is either simple or compound. It is simple when it answers to a single flower leaf, and compound when it answers to two or three, or to a full circle of such leaves. Each pistil's flower leaf, or simple pistil, is called a carpel. Each part flower leaf of a compound pistil is likewise a carpel. When a flower has two or more pistils they are, of course, simple; that is, they are separate carpels, or pistil leaves. There may be only a single simple pistil to the flower, as in the pea or cherry blossom, or there may be two such, as there are in many plants of the Saxifrage Family, or many as in the strawberry. Usually the single pistil in the center of a blossom is a compound one and there is hardly ever any difficulty in ascertaining the number of carpels, or pistil leaves that compose it.

"The simple pistil, according to the views of some who study plants, answer to a leaf blade, with incurved margins that are united where they meet, and so form a closed case, or pod, that bears ovules at the junction of these margins. A tapering upper portion with margins singularly installed, is suppressed to form the style, and these same margins exposed at the tip, or for a portion

of the length, become the stigma. A single pistil has a one-celled ovary, a single style, and a single stigma. But there are certain variations from this normal condition that sometimes occur with the pistil, but it does not invalidate the statement just made."

"What are those conditions, Miss Williams?"

"Well, the stigma may become two-lobed, or two-ridged because it may consist of two-leaf margins. If you could see the simple pistil of the isopyrum with its ovary cut across, you would see that the inner face is turned toward the eye. The ovules seem to be borne on the ventral suture, and therefore answers to leaf margins. The stigma above also answers to leaf margins. So you see, dear, that the pistil may become two-celled, by the turning or growing inward of one of the sutures, so as to divide the cavity.

"There are two or three terms that relate to the parts of a simple pistil or carpel, and are also carried on to the compound pistil as well. The line that answers to the united margin of the carpel leaf and the ventral or inner one because it looks inward, or to the center of the flower, is called the ventral suture, or seam. The line down the back of the carpel that answers to the midrib of the leaf is not a seam. It is the line where many fruits, such as the pea-pods, open. It is called the dorsal suture.

"We will now notice the receptacle. It is that part of the flower that belongs to the stem. In some flowers it is small and short; in others, long, thick, or variously enlarged, and takes on various other forms, and is named accordingly. Flowers with numerous single pistils generally have their receptacle enlarged so as to give them room. Sometimes they become broad and flat, as they are in the flowering raspberry, and sometimes elongated as in the blackberry and magnolia fruit.

"It is the receptacle in the strawberry, Melba, much enlarged and pulpy, when it is ripe, that forms the eatable part of the fruit, and bears the seed-like pistil on its surface. The end of the flower is attained when the ovules become seeds. The flower remains long enough for the fulfilment of this end. The time that the flower remains is called the anthesis. During the anthesis the ovules have to be fertilized by the pollen, or the pollen has to reach the stigma, or ovule itself, to set up the growth that results in the production of an embryo in the ovule. By this the ovules are said to be fertilized. The first step in fertilization is pollination, or sowing the pollen upon the stigma, where it is to germinate.

"Our next talk, Melba, will be upon the fertilization of the stigma; but this is enough for today.

FERTILIZATION OF THE STIGMA.

"Now, Melba, today we want to notice the process by which the stigma becomes fertilized. Sometimes the application of the pollen, to the stigma is left to chance, as it is in the dioicous or wind-fertilized flowers.

In others, the flowers are fertilized in the bud. In some, thepollen isprevented from reaching the stigma of the same flower, although very near it, but there are always arrangements for it to reach the stigma of some other blossom of the kind.

"It is among those flowers that the most exquisite adaptations are met with. Therefore some flowers are particularly adapted to close or self-fertilization, while others are to cross fertilization. Close fertilization occurs when the pollen reaches and acts upon the stigma of the same flower, or upon other blossoms of a cluster of the same plant. Cross fertilization occurs when the ovules are fertilized by the pollen of other individuals of the same specie.

"Hybridization occurs when ovules are fertilized by the pollen of some other nearly related specie. Close fertilization would seem to be the natural result in ordinary hermaphrodite flowers, but it is not true in all of them.

"The arrangements are usually such that it takes place only after some opportunity for cross fertilization has been afforded. Close fertilization is sure in those that are fertilized in the flower bud. Most flowers of this kind never open, for the closed floral coverings are forced off by the growth of the fertilized pistil.

The common examples of that are found in the earlier blossoms of the perfoliate, of the specularia; in the later blossoms of most violets, especially the stemless species, and the wild jewell weed, of the specie of impatients. Every plant that produces these bud-fertilized flowers also bears open flowers that are very conspicuous and usually of bright colors. The open ones seldom ever bear seed, but the former are very prolific.

Cross fertilization depends entirely on the transportation of the pollen. The two principal agents of conveyance of the pollen are the winds and insects, and most flowers in their structure are adapted to one or the other. Wind-fertilized flowers are more commonly dioicious or moniocious, as in the pines and all coniferous trees. The oaks, birches, sedges and some of the hermaphrodite flowers, as the plantain and most grasses. These plants produce a super abundance of very light pollen that is adapted to be wind-borne. They offer no

nectar to feed winged insects, nor fragrance or bright colors to attract them.

"Insect-fertilized flowers are those sought by insects for their pollen or nectar, or for both. Through their visits pollen is carried from one plant and flower to another."

"What is the nectar, Miss Williams?"

"It is the material that honey is made of, and is found in certain flowers. While the bees are supplying their own needs they carry the pollen from anther to stigma and from plant to plant, thus bringing about a certain amount of cross fertilization. Willows and some other dioicious flowers are so fertilized. But most insect-visited flowers have their stamens and pistils associated either in the same or some very near blossoms. Even in the same blossom anthers and stigmas are very often so situated that during insect visitation, some pollen is more likely to be deposited on other stigmas, as well as their own, which gives a chance for cross, as well as close fertilization.

"On the other hand many flowers have their parts so arranged that they must be cross fertilized, or barren, and are therefore dependent on the aid of insects. This aid is secured by different adaptations and contrivances that Mother Nature has arranged for the purpose. Some of the adaptations that favor cross fertilization are peculiar to

the particular kind of blossom, orchids, milk-weeds, kalmia, iris and the papilionaceous flowers. Each have their own special contrivances that are quite different from each other.

"Irregular flowers, and especially irregular corollas, are usually adapted to insect visitation. So are all the cavities in which nectar is secreted, whether they are hollow spurs, sacs or cavities."

"What is the need of all those arrangements, Miss Williams?"

"Well, dear, they must be some essential advantage to plant life, otherwise all the various elaborate and exquisitely adjusted adaptations that are provided for cross fertilization by Mother Nature, would not have been made.

"Our next talk will be on the formation of the baby, or new plant in the seed, and then we will leave the subject altogether."

Melba went to spend the afternoon with her mother.

"Oh! Mother, I am so pleased with my teacher. Of all my studies I like the Nature Study the best. We are just finishing up the subject of flowers and it is perfectly wonderful how much there is to learn about them. Teacher says when I have finished studying the parts of the plants, I will be ready to take them by families. How delighted I will be when I can call each little

plant by its family name, or say to what family it belongs."

FORMATION OF NEW PLANTS.

"Now, Melba, we are on our last subject on flowers. As I told you, we are to talk about the formation of the new plant in the seed. We can only understand it by understanding the action of the pollen and the formation of the embryo.

"A grain of pollen may be likened to a single seed, and like a seed it is capable of germination. When it is deposited on the stigma, it grows from some point.. Its living inner coat breaks through the outer coat, and protrudes in the form of a delicate tube. As this tube lengthens it penetrates the loose tissue of the stigma, and also a loose-conducting tissue in the style and it feeds on a nourishing liquid matter there provided. It finally reaches the cavity of the ovary, enters the orifice of an ovule and attaches its extremity to a sac, or the lining of a definite cavity in the ovule, called the embryo sac. A small portion of the living matter in the embryo sac is formed and is in some way placed in close relation to the apex of the pollen tube. It absorbs the contents of the latter, and then sets up a special

growth, and the embryo, or rudimentary plant-let in the seed is the result.

"We have now finished our talk on flowers, Melba. There are some things about them we did not speak of, for instance, their color and odor. Think what a wonderful variety of color they exhibit. They could have performed their office just as well as they do, without being as beautiful and as sweet as they are. But Mother Nature not only made them beautiful, but sweet. Their many fashioned corollas are bedecked in all colors, shades and tones, simply to please and make us glad to have them. And they are not only beautiful to us, but we have learned how the many sweets that they contain, attract many beautiful insects and some birds to them for the nectar they contain in their pretty cups.

THE FRUIT.

"Well, Melba, we are to take a new subject on plant life today. Can you remember anything you learned about the fruit in any previous lesson, Melba?"

"Yes, I remember that the fruit is produced by the flower."

"That is true. We are now going to learn the nature of the fruit, and from what part of the flower it is produced. The ovary of the flower matures into the fruit and therefore we say, the fruit is the ripened ovary. It is the seed-vessel, as you learned, but the book men call it the pericarp. There are many things connected with the seed-holder or pericarp that must be considered with it, if we are to have a perfect knowledge of its formation.

"The calyx, or a part of it, is often incorporated with the ovary, and when it becomes a portion of the pericarp, it forms along with the receptacle, the whole bulk of such edible fruits as the pear and apple. The receptacle is an obvious part in the blackberry and is the whole edible portion in the strawberry. A cluster of distinct carpels may, in ripening, be consolidated so as to be taken for one fruit. Such is the case in the raspberry, the blackberry, the

fruit of the magnolia and many others. The ripened product of many flowers may be grown together so as to form a single compound fruit. Therefore, there must be a distinction between the various kinds, and names must be given to these classifications so that they can be distinguished one from the other.

"Those fruits that result from the ripening of a single pistil, and consist of only the matured ovary as in the cherry, gooseberry and blackberry which have the calyx tube completely incorporated with it, are called simple fruits. When a cluster of carpels of the same flower are crowded into a mass, as they are in the raspberry and blackberry, it is called an aggregate fruit. When the surrounding or supports of the mass, as the loose calyx changed into a fleshy berry-like envelope, as it is in the wintergreen and buffalo berry, or in an aggregate fruit such as the strawberry and blackberry, they are called accessory fruits. When a fruit is formed from several flowers that are consolidated into one mass, of which the common receptacle, the floral envelope and even the bracts, make a part, it is called a multiple fruit.

"The mulberry and pineapple are examples of the multiple fruit. You can go now, Melba. We will take the kinds of fruit next."

FRUITS CONTINUED.

"We are to talk about the kinds of fruit today, Melba. Fruits are distinguished by their texture or consistence, and are divided into three kinds. Those that are more or less soft and juicy throughout, are called fleshy fruits. Those that have the outer part fleshy like a berry, and the inner part hard or stony like a nut, are called stone-fruits. And those that have no flesh or pulp are called dry fruit.

"We have learned, Melba, that the fruit is a seed-holder. After the vessel or holder ripens, the seeds must find their way out of it so they can perform their function. Mother Nature knew that, and in her provisions, she also arranged a way for the seeds to be disseminated. Therefore, a definite name has been given to them to distinguish the way and the time of opening

"Fruits that do not open at maturity are named indehiscent. Fleshy fruits and stone fruits are of course indehiscent, because the seed becomes free only through decay, or by being fed upon by animals. Many dry fruits are indehiscent, but they are mostly arranged to be transported by animals. Some burst regularly. But many fruits are dehiscent, that is, they open at maturity. They split open regularly along certain lines to discharge their seeds.

"A dehiscent fruit very nearly always contains many seeds, or more than one. We shall name some of the principal fleshy fruits, so you will know them. The berry is one; it has the whole flesh soft throughout. The fruits belonging to the berry class are the gooseberry, currant, blueberry, cranberry and tomato. The orange is also a berry with a leathery rind. The pepo or gourd fruit comes next. It is a hard rinded berry, that belongs to the gourd family. The pumpkin, squash, cucumber and melon make up the list.

"The pome is a name that is applied to the apple, pear and quince. They are fleshy fruits like a berry, but are not produced the same way. They come from the thickening of the calyx. The only part that belongs to the carpels is the papery pods, that are arranged like a star in the core. The fruit of the hawthorn is between the drupe and the pome.

"The fruits that are externally fleshy and internally hard are the drupe or stone fruit. They are the cherry, plum and peach. In this class of fruits, the outer part of the thickness of the pericarp becomes fleshy or softens like a berry, while the inner part hardens like a nut.

"Among the dry fruits, there is a greater diversity of kinds, and each has a distinct name.

"The indehiscent sorts of fruit are commonly one-seeded. We will notice the akene first. It is a small, dry, indehiscent one-seeded fruit. It is often so seed-like in appearance that it is taken for a naked seed. The fruit of the buttercup, or crowfoot, is a good example of the dry fruit. Its nature as a ripened pistil is apparent, because it bears the remains of a style, stigma, or scar, from which it has fallen. It sometimes retains the style which it uses in various ways for dissemination. The akene of the virgin's bower is one. The feathered style aids in dissimination.

"The fruit of the Composite Family is also an akene. In each class of the fruit of that family, the pericarp has an adherent calyx tube. The limb of it, when it has one, is called the pappus. This name was first given to the down of the thistle and like plants, but it is now applied to all the forms under which the limb of the calyx appears. In the lettuce, the dandelion and the like, the seed-like fruit, as it matures, tapers upward into a slender beak.

"A cremocarp is the name given to the fruit of the Parsley Family. It consists of a pair of akens that are united completely in the blossom, but splits into two closed carpels when ripe. The fruit of the sweet-cicely is an example of the cremo-carp. A utricle is the same as an akene, but has a

thin, loose, bladdery pericarp, like that of the goose-foot, or pigweed. When it is ripe, it bursts open irregularly to discharge the seed, or it may open by a circular line round the upper part which falls off like a lid, as it does in the fruit of the amaranth. A grain is like an akene, with the seed adhesive to a thin pericarp throughout, so that fruit and seed are both incorporated in one body, as it is in the wheat, the Indian corn and other kinds of grain.

"A nut is a dry indehiscent fruit, commonly one-celled, one-seeded, and has a hard crustaceous, or bony wall, such as is in the cocoanut, the hazel nut, chestnut, and the acorn.

"The acorn has an involucre at the base, in the form of a cup, that is called the cupule. In the chestnut the cupule forms the burr, and in the hazel nut it is a leafy husk. A key fruit is either a nut, or an akene, and so is any other indehiscent one that is furnished with a wing, like those of the ash and elm. The maple fruit is a pair of keys.

"Dehiscent fruit, or pods, are of two classes; those of a simple pistil or carpel, which dehisces down one side only, or by the inner or ventral suture, is called the follicle. The examples of this class of fruits are seen in the marsh-marigold, peony, larkspur and milk-weed.

"But the pea-pod and the fruit of the

Pulse Family, generally is one which opens along the dorsal, as well as the ventral suture, and is called the legume. The two parts into which it splits are called valves. A loment is a legume that is constricted between the seeds and at length breaks up cross-wise in distinct joints. We will stop now, dear.

COMPOUND OVARY.

"Today, Melba, we take the compound ovary. The pods belonging to a compound ovary have several names, but are all a kind of capsule. The capsule is the dry dehiscent fruit of any compound pistil. It may discharge its seed through chinks, or pores, as it does in the poppy, or burst irregularly in some part, as it does in the lobelia, but they generally open lengthwise into regular pieces called valves.

"You see, Melba, Mother Nature has provided a way whereby the seed of all plants can be distributed. The akene of the virgin's bower and the buttercup, retain their feathered style which aids them in their dissemination. The fruits that look so seed-like are the akene of the Mayweed, that has no pappus; the akene of the succory that has only a shallow cup; the akene of the sunflower, that has a pappus of two scales, and the pappus of the sneeze-wood that has five scales. The akene of the sow-thistle has a pappus of delicate downy hair and the dandelion has its pappus raised on a long beak.

"There is another class of dry fruits we must consider. The fruit of the sweet-

cicely has two carpels. They grow on a slender axis, or stalk that extends between the carpels from which they separate when they are ripe. The fruit of the common pig-weed and of the amaranth has an opening all around. The acorn, or nut of the oak, has a cup, or cupule. The keys of the white ash, which is the fruit of that tree, has a winged end. The samara, or key fruit of the American elm, is winged all around. The fruit of the sugar maple is a pair of keys. The fruit of the marsh-marigold is a follicle, and of the sweet-pea a legume. The fruit of the tich-trefoil is a loment or jointed legume. The fruit of the iris is a capsule and of the marsh St. John's wort, is a pod. The spring-cress bears a silique; the shepherd's-purse a silcel, and the pod of the purslane has a detaching lid.

"The fruit of the fig and the mulberry are multiple, for they consist of a mass of fruits, aggregated in one body. The pineapple is also a multiple fruit. The fig fruit is the fleshy axis, or summit of a stem that is hollowed out and lined within by a multitude of minute flowers, the whole of which becomes pulpy as it is in the common fig.

"The pine and cypress also bear a multiple fruit. The cones are open pistils, mostly in the form of flat scales. They regularly overlap each other and press themselves together into spikes, or heads. Each scale

bears one or two naked seeds on its inner face. When ripe and dry the scales turn back or diverge. The seed of the pine peels off and falls, and generally carries with it a wing; that is, a part of the lining of the scale which assists in the dispersion of the seed by the wind.

"The scale of the cone in the arbor vitea are few, but they look very much like leaves. In the cypress they are very thick at the top and narrow at the base, so as to make a peculiar sort of closed cone. In the juniper and red cedar, the scales of the small cones become fleshy and ripen into a fruit that closely resembles a berry.

"Now Melba, this talk closes the lessons on fruit. You have learned that under that name, many different things are classed. In the fig, it is a hollow flower stalk; in the pineapple and mulberry, it is clusters of flower leaves; in the blackberry and raspberry, little clusters of sterile fruits; in quinces, apples and pears, you eat an enlarged fleshy calyx; in peaches, plums, cherries, apricots and almonds the outer part of a seed-vessel; in grapes, gooseberries, blueberries, currants and cranberries, we eat the whole seed-vessel that has grown rich and pulpy.

"So you see Melba, that Mother Nature made the fruit to perform a two-fold function. It is made to protect the seeds that

are to reproduce the plant, and gives to man one of the most useful and delicious products of the natural world. Nothing has a greater commercial value than fruit, and as you observe and enjoy it, you must always remember that it is not only grown to delight the eye and taste, but it has other values as well."

"What subject shall be take next, Miss Williams "

"We will take the seeds. It is the last subject in the set of talks; but it is rather long and I will let you have several weeks' rest, before we take up the subject. You can read up and endeavor to make fast the knowledge you have on the subjects already taken."

SEEDS.

"We will begin our talks on seeds today, Melba. Seeds are the final product of the flower and is the part to which all the offices of the flower are subservient. All summer long the mother plant works to produce the baby seeds. She gives them food and drink, and you have learned how she wraps them up into cradles, so that nothing can harm them. They rock and sleep in their cradles all summer, but when fall comes, the mama plant goes to sleep, and the seed babies have to care for themselves. So they find a nice warm place down under the leaves and sleep there until spring comes.

"In the fall is the time to visit among the trees and flowers, if you wish to see, and know something of the kinds of cradles the next year's plants are put to sleep in. And as you go in the fields, garden and woods, you will see many kinds of fruit which, as you have learned, are seed-holders. For each plant mama has tucked her seed babies away in a different kind of cradle. You will see some brown ones on the nut trees, red ones on the rose bush and cranberry vines,

striped red, yellow and green ones in the apple orchard, and purple ones on the grape vines. In some of the cradles you will find one seed baby and in others two or three, or maybe a dozen. Our work now, Melba, will be to study the nature of the seed.

"A seed is an ovule fertilized and matured, with a germ or embryo formed in it. It consists of its coats, an outer and an inner one; the outer one hard, hence, it is called the testa or shell of the seed, but the inner one is almost always thin and delicate. The outer coat is sometimes closely fitted to the kernel. It is so in the morning-glory. The kernel is the whole body of the seed within the coats, and consists of the embryo and the albumen. The albumen is the prepared food for the embryo to live on.

"In some cases the outer coat is extended into a border, or wing. We can find that in the trumpet creeper. Occasionally this wing is cut up in shreds or tufts, as it is in the catalpa, or instead of a wing it may bear a coma or tuft of long, soft hairs, as in the milk-weed seeds. The use of these wings, or downy tufts is to render the seeds buoyant, so they can be easily dispersed by the winds. This is clear, not only from their adaptation to this purpose, but also from the fact that winged and turfted seeds are found only in fruit that split at maturity, and never in those that remain closed.

"Mother Nature does not intend the seed babies to remain in one place after they leave the mama plant. She wants them to go and visit other parts and districts, so she has provided means by which they can travel. The maple, linden and oak have wings with which to fly. The touch-me-nots have springs. The burdocks, beggar's ticks, and stick-tights, have little hooks that catch on to the fur of animals and to people's clothes, and are therefore carried from place to place. The seed of the thistle, the milk-weed, the dandelion, aster, golden-rod, and cat-tails have sails with which to travel. Other seeds are scattered by the wind, the water, and by man.

"The coat of some seeds is beset with long hairs or wool. The cotton seed which is one of the most important vegetable products, since it forms the principal clothing of the larger part of the human race, consists of long, woolly hairs that thickly cover the whole surface of the seeds. A few seeds have an additional, but more or less incomplete covering outside of the real seed coats. That cover is called the aril, or arillus. We have a specimen of it in the loose transparent bag, that encloses the seed of the white water-lily, and also in the mace of the nutmeg.

"The aril is a growth from the extremity of the seed-stalk. The scar left from where

the seed-stalk falls away, or where the seed was attached directly to the placenta, where there is no seed-stalk, is called the hilum. The place where the seed coats and the kernel are connected is called the chalaya. The kernel, or nucleus is the whole body of the seed within the coats.

"In many seeds the kernel is all embryo, and the embryo, as you know, is the baby plant, or little plant-let. The albumen that is contained in the seed is intended to nourish the embryo while it grows, until it can provide for itself. The seed vessel, or holder, is to protect and nourish the embryo while it is forming."

"Yes, I remember, that was so clearly brought out in the lesson on the bean."

"The final result of germination, development and blooming, is the embryo, or rudimentary plant-let. Its essential parts are the radicle and the cotyledons. The radicle is the stemlet from which the root starts; the cotyledons the seed leaves. We have already explained the nature of the cotyledons, Melba, but we want to look at them now, with regard to number.

"In the preceding lessons, the cotyledons had only two seed leaves. The embryos of those plants are dicotyledonous. All plants that grow from a two-seed leaved embryo, also agree in the general structure of their stems, leaves and blossoms, and thus form

a class, named from their embryo, dicotyledonous plants.

"Polycotyledonous is a name employed for the less usual case in which there are more than two cotyledons. The pine is the most familiar case. It occurs in all pines, the number of cotyledons being from three to twelve. In the case where there are more than two, they form a circle, or whorl at the summit of the radicle. When there are three, they divide the space equally and are one-third of the circle apart. When only two, they are opposite.

"Monocolyledonous is the name of the one cotyledoned embryo. With it goes peculiarities in stem, leaf and flower that produce a great class called monocotyledonous plants. In this class of plants the leaves are alternate from the first. In the iris, the embryo in the seed, is a small cylinder at one end of a mass of albumen, but it has no apparent distinction of parts. The end which almost touches the seed-coat is the radicle, the other end belongs to the solitary cotyledon. In germination the whole lengthens only enough to push the proximate end fairly out of the seed and from this end the root is formed, and from a little higher the plumule emerges. It would appear, therefore, that the cotyledon answers to a minute leaf rolled up, and that

a chink through which the plumule grows out is a part of the inrolled edges.

"The embryo of the Indian corn shows the parts on a larger scale, and in a more open state. In those seeds the cotyledons remain and imbibe nourishment from the softened albumen and transmit it to the growing root below, and the new forming leaves above.

"The general plan is the same in the onion, but with a striking difference. The embryo is long, and coiled in the albumen of the seeds. To ordinary examination it shows no distinction of parts, but germination plainly shows that all except the lower end of it is cotyledon. After it has lengthened into a long thread, the chink from which the plumule comes, is seen at the base, or near it. So the radicle is extremely short and does not lengthen, but sends out from its base a simple root, and afterwards others in a cluster.

"Not only does the cotyledon lengthen enormously in the seedling, but in those like that of the iris, Indian corn and all the cereal-grains, it raises the light seed in the air, as you saw in the bean, and the tip still remains in the seed and feeds upon the albumen. When that is exhausted and the plant-let well established in the soil, the upper end decays and falls away. In our next lesson we will examine some seeds."

SEEDS CONTINUED.

"We are going to examine some seed today, Melba. Here is a grain of Indian corn. Let's lay it flat-wise and cut away a little, so as to show the embryo. Can you see it?

"Yes, I can. It lies on the albumen."

"So you can see the albumen, can you?"

"Yes, it makes the principal bulk of the seed."

"Here is another grain. We will cut it through the middle in the opposite direction to the way we cut the other grain. What can you say now, dear?"

"We have divided the embryo through its thick cotyledons and its plumule."

"What can you say of the plumule?"

"It consists of two leaves, one enclosing the other."

"That is right. You have stated its position exactly. Here is a third grain. We will take the embryo of it out whole. The thick mess is cotyledon; that narrow body that is partly enclosed by it, is the plumule. The little projection at its base is the radicle. You see it is very short and is enclosed in the sheathing base of the first leaf of the plumule.

"Now let's look at this grain that is germinating. This ascending sprout is the first leaf of the plumule. The younger leaves

are enclosed within it. You see the primary root has broken through at its base. Here is another one at a more advanced stage. You can see the second and third leaves are developing, but the first sheathing leaf does not further develop; it simply developed as a sort of sheath to protect the under parts within, but the second and third ones go on to form the first foliage.

"I have some seeds that have appendages for dissemination. This is the winged seed of the trumpet creeper; this is the seed of the catalpa; here is the seed of the milk-weed, with a coma or tuft or long, silky hairs at one end. These are the seeds, dear, that your story books call the milk-weed babies."

"Why are they called that, Miss Williams?"

"Because the brown seed is taken for the head, and the long, silky hairs are called the dress. All seeds are babies, or hold baby plants. This is the seed of the white water-lily. See, it is enclosed in its aril. This is the seed of the castor-oil plant; this short, thick appendage near the hilum is called the caruncle.

"Now, Melba, we are finishing up the talk on seeds. As you go on your tours of observation don't fail to look for seed pods. As you find new ones, bring them to class. We began our subject by saying that seeds are

the final product of the flower, and for that reason are very important, but aside from the fact that they hold the new plants for the next season's growth, they furnish the food upon which all animal life subsists.

"You know we started by saying the work of the plant is to change air, earth, and water into vegetable matter upon which animal life must depend. I will give you a list of the seed that are used for food and see if you can add to it.

"The seed of the bean vine, the pea, the wheat, the rye, the oats, the corn, the barley, the hickory tree, walnut tree, the almond tree, the peanut, the buckwheat, the butternut, the pepper plant, the rice plant, the hazelnut, and the beechnut. The following are used for medicine: The castor-oil plant; and for spices, the seed of the nutmeg; for beverages, the seeds of the coffee plant and the seeds of the chocolate; for coloring, the seeds of the saffron plant. The matured seed with embryo ready to germinate and reproduce its kind, completes the cycle of vegetable life in a flowering plant.

PLANT CONSTRUCTION.

"Today, Melba, we finish our subject on plant construction and will then take why plants grow, then we are through.

"All plants are constructed on one plan, or type. Take almost any ordinary herb, shrub, or tree for a pattern, and it will exemplify the whole series. The parts of one plant answer to the parts of any other, with only certain differences in particular. The delight of the scientific botanist is in tracing out this common plan and detecting the likenesses under all the diversities, and noting the meaning of these manifold diversities. So the attentive study of any one plant from its growth out of the seed to the flowering and fruiting state, and the production of seed like that from which the plant grew, does not only give a correct general idea of the structure, growth and characteristics of flowering plants in general, Melba, but also serves as a pattern or standard of comparisons from which to work or study.

"Plants have two great peculiarities. First they form themselves, and second they multiply themselves. They reproduce their kind in a continued succession of individuals

and each plant owes its existence to a parent and produces simliar individuals in its turn. These individuals are connected by resemblances or relationships. They group themselves in a cluster and this clustering is the ground of recognition between the same or related kinds. Their relationship is inferred from the close similarity between the plants.

"All plants having their essential organs in common, are classed as related, or as belonging to the same family. A family, therefore, is composed of a group of plants, that essentially resemble each other. The species are the descendants of the same family stock and the varieties are the diffent plants belonging to the same species. Hybrids are the variations that come from crossing of the species."

"Miss Williams, please repeat that."

"Well, first the family; second, the specie; third, variety, and fourth the hybrid. Now when we take up plants by their families, we shall look at them from these four standpoints.

WHY PLANTS GROW.

"Now, Melba, before we leave the subject entirely, I want to give you a talk on why plants grow. Plants with their organs, are kinds of living machines at work, and we want to find out how they operate. To do that we must consider the action of plants.

"Take any plant and examine it and you will see that it is absorbing or drawing in what it lives on. This it obtains from the soil and air. This food consists of moisture, air and other matters that the rain as it soaks in the ground may have dissolved on its way to the roots of the plant. It is by the roots which are lodged in the damp soil that most of the moisture plants feed on is taken in, and with it they always get some earthy matter. Moisture is also absorbed by the leaves that is received by them from raindrops, dew and vapor.

"Plants also absorb air. They have no stomach into which their food passes, and from it into their system, but they absorb it by their surface or skin. When they are very young they absorb by one part as much an another, but as they grow older, and the skin hardens, they absorb by the tips of their roots and by their leaves. The skin of every

leaf is filled with little holes, or mouths, through which the air passes.

"Plants cannot take any food in a solid state; they drink it all in the form of water. When the moisture has reached the leaves with their little mouths exposed to the light and air, most of the water they receive is evaporated. What remains of the moisture is turned into vegetable matter. You can see, therefore, that plants depend greatly on the light. Except in cases where they are fed by vegetable matter prepared beforehand, they cannot grow without the light. Even in those cases it only serves to start the young plant, and when they have exhausted the prepared food, they must work for themselves, and continue to do so throughout the growing season.

"The new made vegetable matter is dissolved in the water, or sap in the leaf, and forms a thin mucilage. This is called prepared or elaborated sap. When it reaches that state, it is ready to be used in the growth of the plant.. It is the same material of which the plant is made and has to be carried to where it is needed and used in the growth of the plant. It may be used at once, or stored up until needed. In annual herbs, it is used for growth or for blossoming as fast as it is made. In biennials like the beet, the carrot and turnip, a part of it is stored up in the root and used

the next year. In perennials as the potato, a part is laid up in the tubers to begin growth the next season. In shrubs and trees, a part is annually deposited in the newest wood and bark to be used for developing the buds the next spring.

"When vegetable matter is laid up, a large part of it is in the form of starch. Nearly the whole bulk of the potato, or grain of corn is starch. It consists of little grains which are like solidified mucilage, and it may be turned into mucilage again. Mucilage, starch, sugar and vegetable matter are all nearly the same. The plant changes into the other as it needs it. For instance, in the leaves of the Indian corn, where it is made, the elaborated sap is in the form of mucilage; in the stalk at the flowering time it is changed into sugar; in the grain a part of it is changed into starch. When the grain is planted and begins to grow, the starch is changed back to sugar, and in the little plant the sugar is changed into vegetable matter."

"I understand it, Miss Williams."

"Yes, I know you do. We shall now have a talk on what plants do. They purify the air for animals by inhaling the poisonous carbonic acid gas, that they need, and by exhaling oxigen that animals need. They make all the food that animals live on. Animals can not live on air, water, or earth;

nor are they able to change them into food that they can live on. The work is done for them by the plants. They furnish us with almost every comfort and convenience. The medicine for restoring, as well as the food for supporting health and strength comes from plants. They furnish all the clothing for man, not only what is made from the cotton plant, flax plant and silk-worm that is fed from the mulberry leaves, but also from the fur and wool of animals that owe their lives to plants.

"Plants furnish utensils, tools and building materials. They supply all the fuel in the world. Plants make the earth beautiful. They are endowed with the power of transforming air, water anl earth into living matter and working them into an infinite variety of beautiful and useful forms. Leaves of every form, flowers of every hue, the large trunk, the fleshy root, hard nut, succulent fruits, the sugar of the orange, the acid of the lemon, the starch of the potato and the oil of the olive, poisonous juices, and refreshing beverages, are all made from sap, and the sap is made from water. The sap of different plants have different tastes; some are sweet, as it is in the maple sugar, sour as it is in the rhubarb; pungent as in the pepper grass, and bitter as in many other plants. But whatever taste or color, it is used to nourish the plant.

THE END.